Insects 3

TECHNICAL SERIES NO. 1.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

REVISION

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OF THE

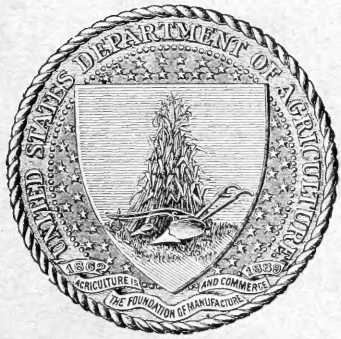
APHELININÆ OF NORTH AMERICA

A SUBFAMILY OF HYMENOPTEROUS PARASITES OF THE FAMILY CHALCIDIDÆ.

BY

L. O. HOWARD,

ENTOMOLOGIST.



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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., June 15, 1895.

SIR: I have the honor to submit for publication the first number of the proposed technical series of bulletins, which, on account of their character, are intended especially for working entomologists, learned societies and periodicals, and libraries. The Aphelininæ, which are monographically considered in this first number, are insects of great economic importance, since they comprise the most abundant of the parasites of our destructive scale insects.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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EXPLANATORY TO THE NEW SERIES.

While the work of the Division of Entomology is entirely carried on with the practical end in view, a certain amount of work of a technical character is constantly being done by different members of the force. The condition of our knowledge of North American insects at the present time is such that many forms which from time to time spring into prominence as destructive species, or as connected with destructive species, either as parasites or predatory enemies, are found to be new to science. They must be classified, described, and given names before they can be intelligently considered in economic publications. The practice which has prevailed to a limited extent of naming and describing new species in practical bulletins and reports is one which has met with much disfavor among systematic workers. Isolated descriptions of new species are in themselves sources of great annoyance to all workers, and when these isolated descriptions are published elsewhere than in scientific journals or the proceedings of scientific societies the annoyance becomes intensified. The force of the Division of Entomology comprises several specialists who are doing descriptive work, and largely upon material accumulated in the course of the regular divisional work. They are doing this work as a necessary supplement to the purely economic output of the Division, and to facilitate the investigations of the entomologists of the State Agricultural Experiment Stations. It becomes important that the results of their labors should be published promptly, and as all available sources of publication in this country, such as the Proceedings of the United States National Museum and the Transactions of the American Entomological Society, are chronically overcrowded with manuscripts, and are not published with any degree of promptitude, it is necessary that they should be issued by this Department.

L. O. H.

THE APHELININÆ OF NORTH AMERICA.

By L. O. Howard.

The minute and structurally interesting species of the chalcidid subfamily Aphelininæ have been studied by systematic workers since the founding of the type genus by Dalman in 1820. This author differentiated the species *A. insidiator* and *A. abdominalis* from the older genus *Entedon*, with which they had previously been associated. In 1833 Westwood established the genera *Coccophagus* and *Agonioneurus*, Dalman's *Aphelinus* having contained species of each. In 1834 Nees von Esenbeck established the genus *Myina*, which corresponded exactly with *Agonioneurus*. In 1839 Walker placed both Westwood's genera together under *Aphelinus*, but in 1846 separated Westwood's *Coccophagus*. Foerster, in his Hymenopterologische Studien, discarded *Aphelinus* on account of its poor definition and *Agonioneurus* on account of its length, retaining *Myina* of Nees and establishing the family Myinoidæ, with the genera *Myina*, *Mesidia*, and *Coccophagus*. In 1876 Thomson revived *Aphelinus* and established the tribe Aphelinina. In 1878 Foerster, in his Kleine Monographie parasitischer Hymenopteren, added the new genera *Encarsia* and *Centrodora*, and referred incidentally to the group as Coccophagoidæ. In 1880 the writer, following Thomson in the revival of the original genus *Aphelinus*, established the higher group as the subfamily Aphelininæ and described a number of species in the genera *Aphelinus* and *Coccophagus*. Since then he has described occasional species in these two genera and has erected three new genera, viz, *Ablerus*, *Aspidiotiphagus*, and *Prospalta*. In 1851 Haldeman erected the genus *Eriophilus* to contain a single species, *E. mali*, parasitic upon *Schizoneura lanigera*, but, as shown by the writer in 1880, this genus is but a synonym of *Aphelinus*. Haldeman made no effort to determine the affinities of his genus, beyond stating that it belonged to the family Chalcididæ. In the previous year, however, Haldeman erected another genus, *Eretmocerus*, to contain the single species *E. corni*, which he reared from *Aleyrodes* found upon the leaves of dogwood. This genus, which Haldeman considered to be allied to *Mymar*, is, as I am able to show by the rearing of new species, a true aphelinine. In 1891 Ashmead placed the genus *Eunotus* of Walker in the subfamily Aphelininæ (Proc. Entom. Soc. Wash., vol. II, p. 108). Foerster had previously noticed the resemblance of this insect in certain characters to this group, but had removed it to the Pteromalinæ, evidently on account of

the number of antennal joints. Later investigations, and particularly the discovery of two new closely allied genera which the writer has described in the Journal of the Linnæan Society of London as *Herbertia* and *Erotolepsia*, have, however, convinced Mr. Ashmead, as he tells me in conversation, that *Eunotus* must properly be placed with the Pireninæ.[1]

On the whole, not much attention has been paid to the insects of this subfamily in Europe. This is probably largely due to the fact that almost no attempt has been made to rear the parasites of Coccidæ. It results, therefore, that the aphelinine fauna of the United States is better known than that of Europe. A number of species were reared in the Department of Agriculture by Professor Comstock when he was engaged upon his study of the scale insects of the United States in 1880, and it fell to the lot of the writer to describe the new forms. Since then others have been reared from time to time and described as indicated above. Mr. Ashmead has also described several forms. Fitch described one which he placed in the genus *Platygaster;* Haldeman, as above stated, described two; Le Baron described one (placing it, by the way, in the proper genus), and the Abbé Provancher has described two, viz, *Coccophagus brunneus* and *C. pallipes*. Unfortunately, however, *C. brunneus* is evidently a tetrastichine, while *C. pallipes* is a *Sympiezis* belonging to the subfamily Eulophinæ.

The Aphelininæ are distinguished from their nearest allies, the Eupelminæ and Encyrtinæ, by the fact that the mesopleura are divided, the middle legs are not specially developed for saltatory purposes (although the insects jump well), and the first tarsal joint of the middle legs is not incrassate, the antennæ are not more than eight-jointed, and the parapsidal sutures are distinct. The mandibles are small, two to three dentate, the maxillary palpi are three-jointed, and the labial palpi are represented by an elongate tubercle. The antennæ are inserted near the clypeus; the scape is long and slender. The front wings lack the postmarginal vein and the abdomen is broadly sessile. In the yellow species, when mounted in balsam, the curious internal structure which is called by Bugnion in his "Developpement, etc., de *l'Encyrtus fuscicollis*," the "mesophragma" (and which, from the fact that it seems to originate from the hinder portion of the mesoscutellum, is probably

[1] The host relations of *Eunotus* were not known until *E. lividus* Ashm. was found in a lot of parasites sent me by Mr. W. G. Johnson, of the Illinois State Laboratory of Natural History on May 1, 1895. Mr. Johnson had reared this series from a *Lecanium* on plum, together with many specimens of *Pachyneuron altiscuta* How. The *Eunotus* is probably a primary and the *Pachyneuron* a secondary parasite of the *Lecanium*. This coccid parasitism would apparently strengthen the idea of the aphelinine affinity of *Eunotus;* but it must be remembered that *Tomocera californica* How., a true Pirenine, is the most abundant parasite of *Lecanium* scales in California and Hawaii.

properly identified) is seen to extend far back into the abdomen, much farther than with Bugnion's Encyrtus.

The insects of this subfamily are all, so far as we know, parasitic either upon the Coccidæ, Aleyrodidæ, or Aphididæ. They are evidently many-brooded, and issue from their hosts indifferently throughout the warmer months of the year, and through the winter in the insectary. With the Aleyrodidæ, Aphididæ, and the Diaspinæ among the Coccidæ, but one specimen, apparently, issues from a single host insect. With the larger naked scale insects, however, several parasites may issue from a single host. Sufficient observations have not been made upon the early stages of the Aphelininæ. Their larvæ feed both upon the body of the scale insect and upon the eggs. They attack both sexes of the host, issuing when full grown through circular holes cut through the body walls, and, in the case of the Diaspinæ, through the scale. With the scale insects of the genus *Pulvinaria*, the aphelinine larvæ live within the body of the female and not in the waxy egg mass which she secretes.

Economically, the Aphelininæ are by far the most important of the parasites of the Diaspinæ. Other scale insects are more abundantly parasitized by species of other groups, notably the Encyrtinæ, but with the Diaspinæ it is really difficult to find an affected tree which does not bear scales pierced by the exit holes of some aphelinine. It was with a species of the genus *Aphelinus* that LeBaron made the first attempt at the transportation of a scale parasite from one region to another in which the parasite was supposed not to occur. As a matter of fact, however, while the numbers of the Diaspinæ are undoubtedly frequently reduced to a considerable extent by the work of the members of this subfamily, I have never seen a plant affected by scale insects in which the Coccidæ were even approximately exterminated by these insects. The claims which were at one time made in California of the extraordinarily beneficial work of *Aspidiotiphagus citrinus* upon *Aspidiotus aurantii* have always seemed to me unjustified, and in this opinion I am supported by the evidence of Mr. D. W. Coquillett, who states that upon personal examination of the orchard in which it was claimed that this parasite had nearly exterminated the scale he found that but a small proportion of the dead scale insects contained the issuing holes of the parasites. The great majority of them seemed to have been killed by some disease.

The larvæ of the early generations of the species of the genus *Aphelinus*, as may be inferred from what I have said in the previous paragraph, feed upon the body of the scale insect, but those of the late generations feed upon the eggs. Confirmatory evidence of the incompleteness of the work of the species of *Aphelinus* has been gained by the careful examination in the early spring of a large number of scales of *Mytilaspis pomorum* parasitized by *Aphelinus mytilaspidis*. Under

the healthy wintering scales of the *Mytilaspis* will be found a varying number of sound eggs, but seldom less than 50, while nearly 100 may be found in a few. Examinations which Mr. Pergande made for me in the early spring of 1895 showed that while some of the specimens of *Aphelinus* had issued from the scales late the previous fall (evidently considerably after the egg laying of the females had been completed), others were present in the full-grown larval condition, ready to transform to pupæ. The latter were in the great majority. In no case, however, had all of the scale-insect eggs been devoured, even with those scales from which the parasite had emerged the previous autumn. Under these latter scales from 5 to 11 sound eggs were found, while under the scales containing full-grown parasitic larvæ from 2 to 18 sound eggs were found. It seems, therefore, that the work of the last generation of *Aphelinus* is no more effective than that of a ladybird beetle, probably not so much so. These beetles tear open the scales and eat the eggs, but frequently do not eat them all. In the latter case, however, the exposure of the eggs may result in their death, whereas the eggs which are left by the *Aphelinus* will undoubtedly hatch. It is unfortunate that the *Aphelinus* larva is not capable of eating everything in sight in the shape of *Mytilaspis* eggs, but we must take the facts as we find them, and it is plain that the good work of these parasites has been overestimated.

When these insects are properly mounted they are not especially difficult to study. The yellow forms have a delicate exoskeleton, and when mounted dry shrivel to some extent. The face falls in and the thorax becomes distorted. If thrown into alcohol they become discolored. If mounted in balsam they also become more or less discolored. All the yellow forms should be mounted in glycerin in a thin cell of Brunswick black. They should be mounted under a lens, and some care taken to spread the wings, legs, and antennæ. Several specimens may be mounted to advantage under a single cover glass. In all cases, however, it is important that a colorational description be drawn up from fresh material, since even with glycerin mounts the colors change to some extent and become more sordid. With the black species, as of *Coccophagus*, the shriveling is not so liable to occur, and the larger species particularly can be studied to advantage from dry mounts on tags. Even so, however, where more than one specimen of a given species is collected or reared, it is very advantageous to mount a portion of the series in glycerin, as above described. Details of structure, aside from sculpture, can be more readily studied from slide mounts.

Twigs and leaves infested with scale insects from which it is expected that these little parasites will issue are preferably placed in small, wide-mouthed jars, the mouth of each jar being wide enough to admit the hand. The mouth of the jar is then covered with thin muslin held

in place by a rubber band, or the glass cover may be placed over the mouth. Careful examination of the sides of the jar with a three-quarter-inch lens will usually enable one to find the parasites after they have emerged. It becomes then a critical question how to get them out of the jar and into a very small vial. This is done by turning the jar on its side with the bottom toward a window. The parasites will immediately jump or fly toward the light, when the cover may be removed and the hand, holding a little vial, inserted. The vial is placed over the parasite, which will immediately give a frantic jump back into it, when the orifice may be closed by the finger and the hand withdrawn from the jar. A little wad of cotton saturated with chloroform is then inserted in the neck of the vial, and as soon as the parasite ceases to move it can be taken out with a delicate brush and mounted, as above indicated.

It is sometimes convenient to use a large vial instead of a wide-mouthed jar for this rearing. In this case, as the hand can not be inserted, it is a more complicated operation to remove the parasites after they have issued. Mr. Pergande accomplishes this in an ingenious way by taking a very small vial and wrapping the outside of its mouth with several thicknesses of paper until it forms a stopper to the larger vial. The combined vials are then held with the small one toward the window, and the parasites will immediately fly into the smaller one, where they may be easily killed and from which they may be removed and mounted. It is fortunate that they have this irresistible impulse to fly toward the light, otherwise it would be most difficult to remove them before mounting.

I have not had an opportunity of examining identified European forms of the subfamily. Twenty-seven species were catalogued by Kirchner, as follows:

MYINIDÆ Foerster.

511. **G. Agonioneurus** Westw.

1. abdominalis *Nees.* Deutsch.
2. Acestor *Walk.* Eng.
3. Argyope *Walk.* Eng.
4. Asychis *Walk.* Eng.
5. basalis *Walk.* Eng.
6. daucicola *Foerst.* Aachen.
7. dubius *Foerst.* Aachen.
8. facialis *Foerst.* Aachen.
9. flavicornis *Foerst.* Wien. Gez. aus *Aphis papaveris* Fb.
10. flavus *Nees.* Deutsch.
11. Idæus *Walk.* Eng.
12. locustarum *Giraud.* Wien.
13. lycimnia *Walk.* Eng.
14. Inaron *Walk.* Eng.
15. Moeris *Walk.* Eng.
16. Proclia *Walk.* Eng.
17. tibialis *Nees.* Wien. Aus *Aphis chenopodii.*
18. varipes *Foerst.* Wien. Gezog. aus *Aphis viciæ.*

512. **G. Coccophagus.**

1. insidiator *Dalm.* Deutsch., Wien.
2. obscurus *Westw.* Eng. (Aphelinus obscurus *Walk.* Mon. Chal. I, p. 6.)
3. scutellaris *Dalm.* Schweden.

513. **G. Mesidia** Foërst.

1. M. pallida *Kirch.* Im Grase im Prater, Augarten, und bei Klosterneuburg.

* * * * * * *

546. **G. Coccobius** Rtzb. (under Encyrtinæ).

1. annulicornis *Rtzb.* Preussen.
2. circumscriptus *Rtzb.* Preussen. In *Coccus pini.*
3. flavus *Nees.* Preussen; (Pallidus *Rtzb.,*) aus *Coccus tiliæ* und *aceris.* Wien.
4. luteus *Rtzb.* Preussen. In *Coccus pini.*
5. notatus *Rtzb.* Preussen. In *Aspidiotus rosæ.* Wien.

The Ratzeburgian species of *Coccobius*, five in number, are catalogued with the Encyrtinæ. I have examined the original descriptions of nearly all of the species listed above, but with little satisfaction. They are invariably insufficient to establish specific identities, although their generic affinities can in many cases be told. Thus, of Kirchner's list, *abdominalis* Dalman (not Nees), *tibialis*, *asychis*, *basalis* Westwood (not Walker), *flavus* and *proclia* belong to *Aphelinus;* while *argiope*, *moeria*, *inaron*, *lycimnia*, and *idæus* belong apparently to *Coccophagus. Flavicornis* and *varipes* are probably species of *Aphelinus.* Of Ratzeburg's species, described under *Coccobius*, *notatus* is a *Coccophagus*, and *pallidus* is an *Aphelinus.* The position of the remaining three is doubtful, but I should not be surprised if it were eventually ascertained that *annulicornis* belongs to *Physcus*, *circumscriptus* to *Prospalta*, and *luteus* to *Ablerus.* Mr. Ashmead possesses a pair of specimens from Germany labeled in Foerster's handwriting "*Coccophagus xanthostictus* Ratz.," which, as a matter of course, are correctly placed generically, and which differ specifically from any of our North American species, resembling most closely *C. flavifrons* Howard, from California.

As to possible identities between European and American forms, we can only guess at present.[1] It is possible that *Aphelinus mali* (Haldeman), the widespread American parasite of Aphididæ, will prove to be a synonym of *A. basalis* Westwood, while *Coccophagus lecanii* (Fitch) may prove a synonym of *C. scutellaris* (Dalman), and *C. immaculatus* Howard may prove identical with *C. insidiator* (Dalm.). The question can not be satisfactorily settled by existing descriptions. To give an idea of the difficulty surrounding this question we give Dalman's description of *C. scutellaris:* "Niger, scutelli macula flava, antennis fuscis;

[1] Since the above was written I have received a small sending of parasites of Coccidæ from Prof. A. Berlese, Scuola Reale di Portici, Italy, in which I have been able to recognize three of the species treated in this revision. These are *Aspidiotiphagus citrinus* (Craw), which Professor Berlese has reared from a species of *Mytilaspis* on olive, from an *Aspidiotus* on *Acacia longifolia*, and from *Diaspis rosæ* on *Ribes rubrum; Aphelinus fuscipennis* How., from an *Aspidiotus* on *Acacia longifolia*, and *Prospalta aurantii* (How.), from *Aspidiotus ederæ*, and from *Leucaspis pinifoliæ* on *Pinus canariensis.* It is impossible to say whether these three species are of European or American origin. If European, as is quite likely, I am totally unable to identify them with published European descriptions. For the present, therefore, the American names must hold.

pedibus flavis femoribus posticis nigris; alis immaculatis." (Kongl. Vetenskaps—Akad. Handlingar, 1825, p. 365.)

An Indian species, *Aphelinus theæ* Cameron, has been reared by Mr. E. E. Green, of Punduloya, Ceylon, from *Aspidiotus theæ*, and described by Cameron in the Mem. and Proc. Manchester Lit. and Philosoph. Soc., series 4, vol. IV, p. 183.

HOST RELATIONS OF THE SPECIES HERE TREATED.

LIST OF PARASITES AND HOSTS.

Parasite.	*Host.*
Eretmocerus corni	Aleyrodes corni.
Eretmocerus californicus	Aleyrodes on Quercus agrifolia.
Pteroptrix flavimedia	Aleyrodes spp. on Iris.
	Fuchsia.
	Sonchus.
	Willow.
	Sambucus.
	Aquilegia.
Perissopterus pulchellus	Asterolecanium on basswood.
	Chionaspis pinifoliæ.
	Prosopophora on cottonwood.
	Aspidiotus sp. on currant.
Perissopterus mexicanus	Ceroplastes sp.
	Pseudococcus yuccæ.
	Lecanium hesperidum.
Aphelinus mali	Schizoneura lanigera.
	Glyphina eragrostidis.
	Aphis brassicæ.
	Pemphigus fraxinifolii.
	Aphis monardæ.
	Siphonophora rosæ.
Aphelinus mytilaspidis	Mytilaspis pomorum.
	Chionaspis pinifoliæ.
	Diaspis carueli.
	Aspidiotus perniciosus.
Aphelinus abnormis	Mytilaspis pomorum.
Aphelinus diaspidis	Diaspis rosæ.
	Mytilaspis sp. on Dycaste.
	Aspidiotus juglans-regiæ.
Aphelinus fuscipennis	Aspidiotus perniciosus.
	Aspidiotus camelliæ.
	Chionaspis euonymi.
	Mytilaspis gloverii.
	Mytilaspis pomorum.
Encarsia luteola	Aleyrodes sp.
Encarsia coquillettii	Aleyrodes sp. on Sonchus.
Encarsia angelica	Aleyrodes sp. on willow.
Aspidiotiphagus citrinus	Aspidiotus aurantii var. citrinus.
	Aspidiotus perniciosus.
	Aspidiotus ficus.
Coccophagus lecanii	Lecanium quercitronis.
	Pulvinaria innumerabilis.
	Lecanium pruinosum.

Parasite.	*Host.*
Coccophagus lecanii	Lecanium persicæ.
	Lecanium on plum.
	Pseudococcus aceris.
	Lecanium hesperidum.
Coccophagus fraternus	Lecanium persicæ.
Coccophagus cognatus	Lecanium hesperidum.
	Lecanium sp. on plum.
	Lecanium persicæ.
Coccophagus immaculatus	Eriococcus azaleæ.
Coccophagus flavifrons	Lecanium sp. on Pinus australis.
Coccophagus flavoscutellum	Lecanium hesperidum.
	Lecanium spp. from California.
	Dactylopius destructor.
	Lecanium tulipiferæ.
	Pulvinaria on plum.
	Pulvinaria on Sullengia.
	Pulvinaria innumerabilis.
	Lecanium on plum.
	Lecanium sp. on Adenostoma.
	Lecanium sp. on Arctostaphylos.
Coccophagus californicus	Icerya purchasi.
Coccophagus lunulatus	Aspidiotus aurantii.
Coccophagus scutatus	Kermes sp. on Quercus agrifolia.
Coccophagus ochraceus	Lecanium sp. on Adenostoma fasciculatum.
Prospalta murtfeldtii	Aspidiotus uvae.
	Aspidiotus sp. on cherry.
	Aspidiotus sp. on currant.
Prospalta aurantii	Aspidiotus aurantii var. citrinus.
	Aspidiotus ancylus.
	Aspidiotus pini.
	Aspidiotus juglans-regiæ.
	Mytilaspis citricola.
	Mytilaspis albus var. concolor.
	Mytilaspis eucalypti.
	Lecanium persicæ.
	Chionaspis sp. on undetermined food plant.
Ablerus clisiocampæ	Chionaspis furfurus.
	Aspidiotus sp. on pear and apple.
Physcus varicornis	Aspidiotus ancylus.
	Chionaspis quercus.
	Chionaspis americana Johnson MS.

LIST OF HOSTS AND PARASITES.

Family APHIDIDÆ.

Hosts.	*Parasites.*
Aphis brassicæ	Aphelinus mali.
Aphis monardæ	Aphelinus mali.
Siphonophora rosæ	Aphelinus mali.
Glyphina eragrostidis	Aphelinus mali.
Pemphigus fraxinifolii	Aphelinus mali.
Schizoneura lanigera	Aphelinus mali.

Family COCCIDÆ.

Aspidiotus ancylus	Prospalta aurantii.
	Physcus varicornis.

Hosts.	*Parasites.*
Aspidiotus aurantii, var. citrinus	Aspidiotiphagus citrinus.
	Coccophagus lunulatus.
	Prospalta aurantii.
Aspidiotus pini	Prospalta aurantii.
Aspidiotus ficus	Aspidiotiphagus citrinus.
Aspidiotus perniciosus	Aphelinus fuscipennis.
	Aphelinus mytilaspidis.
	Aspidiotiphagus citrinus.
Aspidiotus uvæ	Prospalta murtfeldtii.
Aspidiotus camelliæ	Aphelinus fuscipennis.
Aspidiotus juglans-regiæ	Aphelinus diaspidis.
	Prospalta aurantii.
Aspidiotus sp. on Sonchus	Encarsia coquillettii.
Aspidiotus sp. on cherry	Prospalta murtfeldtii.
Aspidiotus sp. on currant	Prospalta murtfeldtii.
	Perissopterus pulchellus.
Aspidiotus sp. on pear and apple	Ablerus clisiocampæ.
Diaspis carueli	Aphelinus mytilaspidis.
Diaspis rosæ	Aphelinus diaspidis.
Mytilaspis albus var. concolor	Prospalta aurantii.
Mytilaspis citricola	Prospalta aurantii.
Mytilaspis eucalypti	Prospalta aurantii.
Mytilaspis gloverii	Aphelinus fuscipennis.
Mytilaspis pomorum	Aphelinus mytilaspidis.
	Aphelinus abnormis.
	Aphelinus fuscipennis.
Mytilaspis on Dycaste sp	Aphelinus diaspidis.
Chionaspis euonymi	Aphelinus fuscipennis.
Chionaspis furfurus	Ablerus clisiocampæ.
Chionaspis pinifoliæ	Perissopterus pulchellus.
	Aphelinus mytilaspidis.
Chionaspis quercus	Physcus varicornis.
Chionaspis americanus	Physcus varicornis.
Lecanium hesperidum	Perissopterus mexicanus.
	Coccophagus lecanii.
	Coccophagus cognatus.
	Coccophagus flavoscutellum.
Lecanium persicæ	Coccophagus lecanii.
	Coccophagus fraternus.
	Coccophagus cognatus.
	Prospalta aurantii.
Lecanium pruinosum	Coccophagus lecanii.
Lecanium quercitronis	Coccophagus lecanii.
Lecanium tulipiferæ	Coccophagus flavoscutellum.
Lecanium sp. on Arctostaphylos	Coccophagus flavoscutellum.
Lecanium sp. on Adenostoma	Coccophagus flavoscutellum.
Lecanium sp. on Adenostoma fasciculatum	Coccophagus ochraceus.
Lecanium sp. on plum	Coccophagus cognatus.
Lecanium sp. on Pinus australis	Coccophagus flavifrons.
Lecanium spp. from California	Coccophagus flavoscutellum.
Asterolecanium on basswood	Perissopterus pulchellus.
Pulvinaria innumerabilis	Coccophagus lecanii.
	Coccophagus flavoscutellum.
Pulvinaria sp. on Sullengia	Coccophagus flavoscutellum.

Hosts.	*Parasites.*
Pulvinaria sp. on plum	Coccophagus flavoscutellum.
Pseudococcus aceris	Coccophagus lecanii.
Pseudococcus yuccæ	Perissopterus mexicanus.
Prosopophora on cottonwood	Perissopterus pulchellus.
Eriococcus azaleæ	Coccophagus immaculatus.
Ceroplastes sp	Perissopterus mexicanus.
Dactylopius destructor	Coccophagus flavoscutellum.
Icerya purchasi	Coccophagus californicus.
Kermes sp. on Quercus agrifolia	Coccophagus scutatus.

Family ALEYRODIDÆ.

Aleyrodes corni	Eretmocerus corni.
Aleyrodes Iris	Pteroptrix flavimedia.
[illegible]achsia	Pteroptrix flavimedia.
Sonchus	Pteroptrix flavimedia.
Willow	Pteroptrix flavimedia.
Sambucus	Pteroptrix flavimedia.
Aquilegia	Pteroptrix flavimedia.
Quercus agrifolia	Eretmocerus californicus.
Willow	Encarsia angelica.
Aleyrodes sp	Encarsia luteola.

ANALYSIS OF THE GENERA.

Tarsi 4-jointed.
- Male antennæ 3-jointed; female antennæ 5-jointed ..... *Eretmocerus*
- Antennæ of both sexes 8-jointed ..... *Pteroptrix*

Tarsi 5-jointed.
- Anterior wings with a hairless line extending obliquely and transversely to base of wing.
  - Three antennal joints before the club of equal length ..... *Mesidia*
  - Three antennal joints before the club of unequal length.
    - Ovipositor exserted to from one-fifth to one-third length of abdomen.
      - Notal sclerites normal, wings hyaline ..... *Centrodora*
      - Mesopostscutellum acutely triangular; forewings with an irregular pattern of rather broad dark lines ..... *Perissopterus*
    - Ovipositor not at all, or but slightly exserted ..... *Aphelinus*
- Anterior wings without oblique transverse hairless line.
  - Male antennæ 4-jointed (one ring joint); female antennæ 6-jointed (3 ring joints) ..... *Plastocharis*
  - Antennæ of both sexes 8-jointed.
    - Club apparently 2-jointed ..... *Encarsia*
    - Club 3-jointed.
      - Stigmal vein lacking; wings with very long fringe ..... *Aspidiotiphagus*
      - Stigmal vein present; marginal cilia short.
        - Marginal vein as long as or longer than submarginal ..... *Coccophagus*
        - Marginal vein much shorter than submarginal ..... *Prospalta*
  - Antennæ 7-jointed.
    - Club composed of but one joint; ovipositor extruded to half length of abdomen ..... *Ablerus*
    - Club 2-jointed; ovipositor scarcely extruded ..... *Physcus*

Genus ERETMOCERUS Haldeman.

Eretmocerus Hald., Amer. Journ. Science, vol. IX, pp. 110, 111, May, 1850.

This genus, which Haldeman did not place, was put by Cresson, in his Synopsis, in the Mymarinæ, which subfamily was located with the Proctotrypidæ. The reason for this placing was probably the fact that Haldeman placed the genus *Amitus*, described immediately before *Eretmocerus*, in the Mymarinæ. Mr. Ashmead, in his monograph of the Proctotrypidæ, places *Amitus* in the proctotrypid subfamily Platygasterinæ, and in making the necessary studies upon this genus, recognized the aphelinine affinities of *Eretmocerus*, the antennæ figured by Haldeman resembling very considerably the antennæ of the genus *Plastocharis* Förster. In studying a series of parasites reared by Mr. Coquillett in California from *Aleyrodes*, I have been delighted to recog-

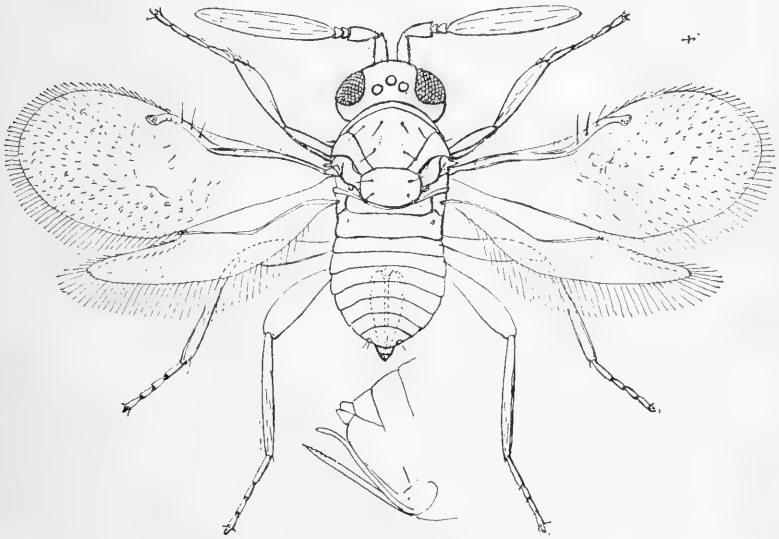

FIG. 1.—*Eretmocerus californicus* Howard: female, showing side view of genitalia below—greatly enlarged (original).

nize a form which belongs, with little doubt, to *Eretmocerus*. Haldeman described the genus only from two mutilated specimens reared from *Aleyrodes corni*, and which he states were "imperfectly examined." Among Mr. Coquillett's specimens were fortunately many males, so that I am able to redescribe the genus in full. The differences between the form which I have studied and Haldeman's description are as follows:

Haldeman states that the tarsi are "apparently pentamerous," eyes hairy, and antennal club oar-shaped (whence the generic name).

In the form which I have studied, the tarsi are 4-jointed (a discrepancy owing, no doubt, to the fact that I have been able to see them clearly under a high power), the eyes are not hairy, and the antennal

club is subellipsoidal. The two latter differences, then, are specific simply, and the first is apparently founded upon imperfect observation on the part of Haldeman.

The generic characters are plainly brought out in the figures. Especial attention is drawn to the fact that the marginal vein is about equal to the stigmal in length. The apical cilia of the forewings are short; the lower border of the mesoscutar parapsides is strongly curved, the male genitalia are, in most specimens, strongly exserted, and the penis is not perceptibly notched. The female genitalia are not produced beyond the tip of the abdomen. The male antennæ are 3-jointed, lacking all trace of the two ring joints seen in the female. The club is very long, twice as long as that of the female, subcylindrical, rounded at tip, and furnished with many long sensory spots. The mandibles are 3-dentate.

ANALYSIS OF THE SPECIES OF ERETMOCERUS.

Eyes hairy, antennal club of female oar shaped ..... *corni*
Eyes naked, antennal club of female ellipsoidal ..... *californicus*

Eretmocerus corni Haldeman (fig. 2).

Eretmocerus corni Haldeman. American Journal of Science, vol. IX, pp. 110, 111, May, 1850.

Haldeman's original description included both generic and specific characters confused together. The species has not been found since, and we can only quote his words:

"Two mutilated specimens of another species of parasite were raised with the preceding and imperfectly examined. The color is pale flavous; the wings have a subcostal nerve not quite straight, ending in a short stigmal branch about the middle, the wings in all other respects as in *Amitus;* feet slender and apparently pentamerous; *eyes* black, covered with numerous short *erect bristles*, more distinct than in *Chelonus;* head, thorax, and abdomen closely united, thorax large, abdomen with sides parallel and the apex obtusely rounded; in one specimen (♂ ?) the abdomen seems but half the width of the thorax, and in the other its sides form straight lines with it; *antennæ* (see annexed figure) 5-articulate, shorter than the body, scapus narrowed toward its apex, second articulation obconic, third and fourth very short, fifth oar-shaped (whence the generic name), longer than all the preceding united, widened toward the apex, which is obtusely rounded. It may possibly be parasitic in the larva of the *Amitus* described above, as it is somewhat less in size. I propose to name the genus *Eretmocerus*, and the species *E. corni*."

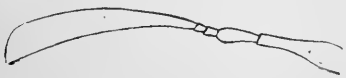

FIG. 2.—Antenna of *Eretmocerus corni* Haldeman—very greatly enlarged (redrawn from Haldeman).

Eretmocerus californicus n. sp. (figs. 1 and 3).

Female (*fig. 1*).—Length, 0.8 mm.; expanse, 1.5 mm.; greatest width of fore-wing, 0.23 mm. Antennal scape short, inserted just above

border of mouth. Flagellum a little longer than width of head. Pedicel large, triangular, followed by two ring joints and a long, stout, ellipsoidal club. General color uniform pale yellow; eyes black; ocelli coral red; wing veins nearly hyaline. Ovipositor scarcely visible from above.

Male (*fig. 3*).—Differs from female mainly in structure of antennæ. Scape subjointed, ring joints are absent, and club is very long and as stout as pedicel. Club is flexible and is usually bent downward, the bend occurring a little below the middle; it is a little longer than head and thorax together. The genitalia are strongly exserted, the intromittent organ pointed at tip, and resembling an ovipositor.

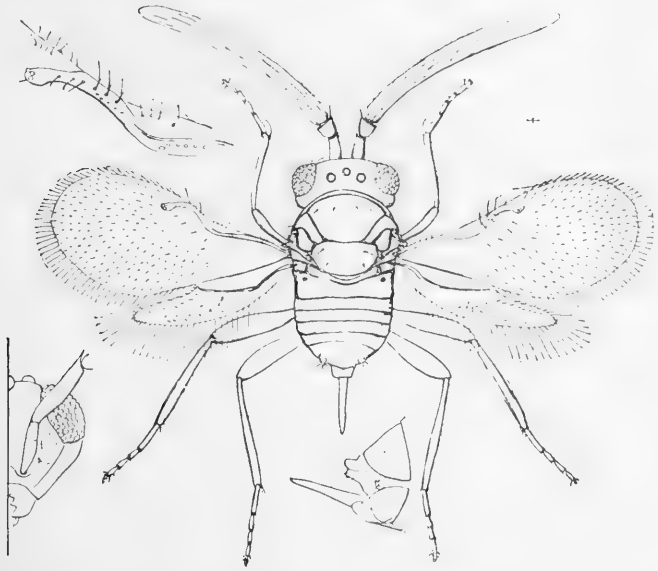

FIG. 3.—*Eretmocerus californicus* Howard: male, showing genitalia below, wing venation and front view of head at left—greatly enlarged (original).

Described from many male and female specimens reared in June and October from an undescribed *Aleyrodes* on *Quercus agrifolia* at Los Angeles, Cal., by Mr. D. W. Coquillett.

Genus PTEROPTRIX Westwood.

Pteroptrix Westwood. Lond. and Edinb. Phil. Mag., vol. III, 1833, pp. 333, 334.

It is a pleasure to restore Westwood's *Pteroptrix* to the group with which he originally considered it to be affiliated. In his original description his opening statement is that it is near *Agonioneurus* (*Aphelinus*). The 4-jointed tarsi of this insect have, however, misled other writers. Foerster, largely on this account, placed it in the Tetrastichinæ, but showed that it differed from the majority of these forms in the lack of the furrows of the scutellum, and suggested its

affinity with the Trichogramminæ. He seems, however, to have had another and true tetrastichine form before him which he considered identical with *Pteroptrix*. In his Nachtrag he changes the name *Pteroptrix* (which, by the way, he spells *Pterothrix*, as amended by Nees) to *Gyrolasia*, on account of the preoccupation of the former name by a genus of composite plants. On account of the probability that he had before him a true tetrastichine, we can retain the genus *Gyrolasia* in the Tetrastichinæ, and since we have what is, with little doubt, Westwood's form, which, upon close study, proves to be an aphelinine in spite of its 4-jointed tarsi, Westwood's original name may be revived under its original form, Foerster's reasons for changing the name being insufficient. The doctrine that "once a synonym always a synonym" will hardly hold here, if we are correct in our supposition that Foerster had a different form before him.

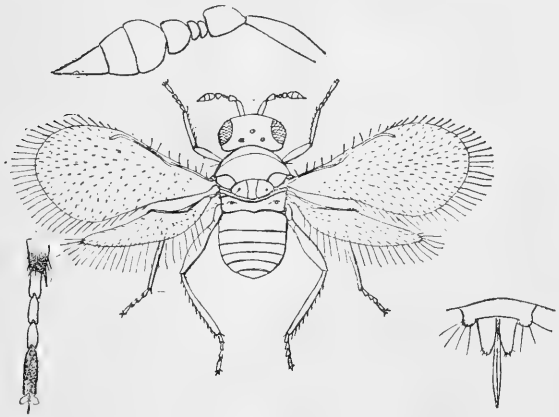

FIG. 4.—*Pteroptrix flavimedia* (Howard): male; female genitalia at right, enlarged middle tarsus at left, antenna above—greatly enlarged (original).

The main characters by which the genus may be distinguished are as follows:

Antennæ 8-jointed, pedicel broad and very short, joints 1 and 2 of flagellum very short and narrow, as in Aphelinus, third, fourth, fifth, and sixth joints forming the club, third sometimes distinct from the club. Mesoscutar parapsides short, reaching only to tegulæ; scutellum transversely elliptical; marginal vein of forewings long, much longer than stigmal. Wings with rather long marginal cilia. Abdomen rounded, perfectly sessile; middle tibial spurs short; tarsi 4-jointed; first, second, and third joints subequal in length, fourth joint considerably longer. This last is an unusual character and would indicate the possible coalescence of the normal fourth and fifth joints.

Pteroptrix flavimedia (Howard) (fig. 4).

Gyrolasia flavimedia Howard. Report of the Entomologist, Annual Report Department Agriculture, 1880, p. 369, Pl. XXIV, fig. 5.

Male and female.—Length, 0.7 mm.; expanse, 1.9 mm.; greatest width of fore wing, 0.32 mm. Antennæ short, sparsely covered with short hairs; scape slender; pedicel broader, twice as long as broad; funicle 3-jointed, joint 1 very minute (a true ring joint), joint 2 nar-

rower than pedicel, broader than long, considerably larger than joint 1. Joint 3 longer than 1 and 2 together and broader than long. Club very broad at base, 3-jointed, acuminate at tip, broadest portion near end of first joint. Joint 3 longest, joint 1 next, joint 2 shortest. Head with sparse but very noticeable stout hairs. Eyes naked. General color deep black, with slight metallic reflections on dorsum of thorax. Second abdominal segment yellow, but when abdomen is bent upward or shrunken this color is hidden. Antennal scape black; remaining joints yellowish brown; tarsi yellowish; last joint dark brown or black. Femora and tibiæ dark brown, except front tibiæ, which are lighter. Entire abdomen sometimes light brown, particularly with male, the venter being lighter than dorsum. Mouth-parts honey yellow or light brown, with a honey-yellow band on prosternum at insertion of front coxæ. Wing veins black, very distinct, forewings with a large dusky patch below submarginal vein.

Described from many male and female specimens. Types were reared in this office from specimens of *Aleyrodes* collected by Professor Comstock on *Iris* at Los Angeles, Cal., and from an *Aleyrodes* on *Fuchsia* collected in the same locality by Alex. Craw in 1879. A large series of the same species was also bred by Mr. Coquillett eight years later at Los Angeles, Cal., from the same *Aleyrodes* on *Fuchsia* (October 4); from an *Aleyrodes* on *Sonchus* (September 16–21); and from another species of the same genus on willow (September 17), as well as from an *Aleyrodes* on *Sambucus* (October 21). Another series of nine specimens was reared by Mr. T. D. A. Cockerell from *Aleyrodes* on *Aquilegia* at Las Cruces, N. Mex., November 20, 1894; and a single male of what may be the same species was also reared by Mr. Cockerell from an *Aleyrodes* at Kingston, Jamaica.

Genus MESIDIA Foerster.

Mesidia Foerster. Hymenopterologische Studien, Heft. II, p. 30, 1856.

This genus is unknown to me. A very brief characterization, however, which Foerster gives distinguishes it well from all other genera. The forewings have the oblique hairless line, and the three joints before the club of the antennæ are of equal length. It is said to be intermediate in its characters between *Coccophagus* and *Aphelinus*.

Genus CENTRODORA Foerster.

Centrodora Foerster. Kleine Monographien, 1878, pp. 66, 67.

This genus is also unknown to me. The head is as broad as the thorax, the antennæ 6-jointed, scape of male broad; with the female the pedicel is of the usual form, with two ring joints following, of which the first is smaller than the second. The third funicle joint is somewhat longer than the pedicel, and the fourth is very long, but not as

long as the others together. The parapsidal sutures of the mesoscutellum are plain; the mesoscutellum and the mesoscutum are large, the abdomen is as long as the head and thorax, and the ovipositor extrudes about one-third the length of the abdomen; the middle tibia with a long spur, the front femora of the male strongly thickened. The wings are longer than the abdomen, and narrow. The marginal vein is as long as the submarginal and reaches the middle of the wings. The stigmal is short; the hind-wings only have long apical cilia.

PERISSOPTERUS new genus.

Type: *Aphelinus pulchellus* How.—Ann. Rept. Dept. Agr., 1880, p. 356.

Antennæ apparently 6-jointed, inserted below middle of face; scape not long, swollen toward tip; pedicel one-third length of scape; funicle joints 1 and 2 very small, almost like ring joints; funicle joint 3 as long as pedicel, broadening toward tip and forming with club a broad-ovate mass; club undivided, about twice as long as funicle joint 3. Face

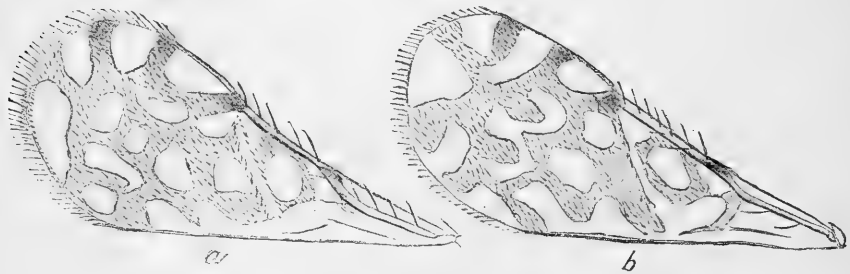

FIG. 5.—Wings of *Perissopterus: a, pulchellus; b, mexicanus*—greatly enlarged (original).

excavated, vertex wide, ocelli at angles of nearly right-angled triangle. Mesoscutar parapsides narrow, very oblique; mesoscutellum broad, rounded at tip; mesopostscutellum and metascutum plainly divided transversely into three sclerites, the central one of each triangular, its rather sharp point directed posteriorly. Forewings with a narrow, oblique, hairless streak, and ornamented with an irregular pattern of rather broad, dark lines, composed of stout black cilia with granular dark dots between; the cells and spaces between these dark lines silvery white and bearing smaller and more delicate white discal cilia; submarginal and marginal veins subequal in length; stigmal given off at about half the wing length, very short and stout; marginal cilia moderate. Hind wings rather broad, rounded at tip, hyaline. Abdomen very concave above in dry specimens, perfectly sessile, rounded at tip; ovipositor extruded for about one-fifth length of abdomen.

This remarkable and handsome genus approaches *Aphelinus* in the structure of its antennæ and Centrodora in its extruded ovipositor. Its middle tibial spur is stronger than is common among the Apheli-

ninæ, and its extraordinary wing markings, as well as the peculiar formation of the notal sclerites behind the mesoscutellum distinguish it widely from hitherto described genera. The type described by the writer as *Aphelinus pulchellus* in the Annual report of the Department of Agriculture for 1880 is known from a single female specimen only, which was reared from a common *Asterolecanium* on linden in the District of Columbia. Upon this single specimen I did not care to erect a new genus. Recently, however, several specimens of an allied though congeneric species have been reared from Coccidæ sent in by Mr. C. H. Tyler Townsend from Guadalajara, Mexico. One specimen he reared himself some three years ago from a Ceroplastes, another specimen we have reared from *Pseudococcus yuccæ* collected by Mr. Townsend on Pelargonium at Aguas Calientes, Mexico, and three other specimens have been reared from specimens of *Lecanium hesperidum* collected by Mr. Townsend on lime at San Luis, Mexico.

ANALYSIS OF THE SPECIES OF PERISSOPTERUS.

General color white, tinged in spots with dark, reddish orange, dotted with black ..... *pulchellus*

General color light orange-yellow, dotted with black, no admixture of reddish or white ..... *mexicanus*

(The specific differences between the two species in the wings, as shown in the figure, will enable the readiest recognition of the species.)

Perissopterus pulchellus (Howard) (figs. 5 *a* and 6).

Aphelinus pulchellus Howard. Report of the Entomologist, Annual Report Dept. Agric. 1880, p. 356.

Female.—Length, 1 mm.; expanse, 2.2 mm.; greatest width of fore-wings, 0.41 mm. (For some unexplained reason the measurements given in the original description are erroneous. Those just given were taken recently from the type.) Head and thorax quite uniformly but finely punctate; mesoscutellum more coarsely than other parts. Head and thorax white, tinged in spots with orange, except at sides of metathorax, which are blackish; propleura white; mesopleura blackish; mesosternum brown; eyes bluish white; antennal scape white, with a longitudinal narrow black stripe below; pedicel white, with a black stripe below, dark brown at base above. Joints 1 and 2 of funicle dark brown; joint 3 white, with a dark brown patch at base and above. Club with basal two-thirds dark brown, yellow at tip; two large brown spots on lower side of cheeks; face and vertex white; hairs on vertex brown, ocelli reddish. All legs white; femora spotted with black, tibiæ banded with black. Hind coxæ dusky, middle and fore coxæ white; each tibia with three equidistant black bands. First, second, and fifth tarsal joints black; third and fourth yellowish; middle tibial spur jet black. Abdomen yellowish, brown above, darker in middle, sometimes black; sides white, with irregular subcircular black markings; ovipositor black; wings hyaline, with an irregular pattern of open net-

work in fuscous; cilia upon fuscous portion very strong and black, on the remainder small and white. The pattern of the network of the type specimen is shown in fig. 5 *a*, but it varies considerably, as is shown by recently reared additional specimens. The clear oblique line is narrow and perfectly straight; the hind-wings entirely hyaline.

Male.—Smaller than the female, which it otherwise closely resembles. The general color is darker and the black markings are broader. The penis is long; the abdomen of one specimen is entirely black above and of another yellowish, with black transverse bands at joints.

Originally described from one female specimen reared from *Prosopophora* on linden in the District of Columbia in 1879. Four additional specimens, two females and two males, were reared in April, 1895, from the same host insect. Other specimens have been reared from *Chionaspis pinifolii* received from Providence, R. I., and from a *Prosopophora*

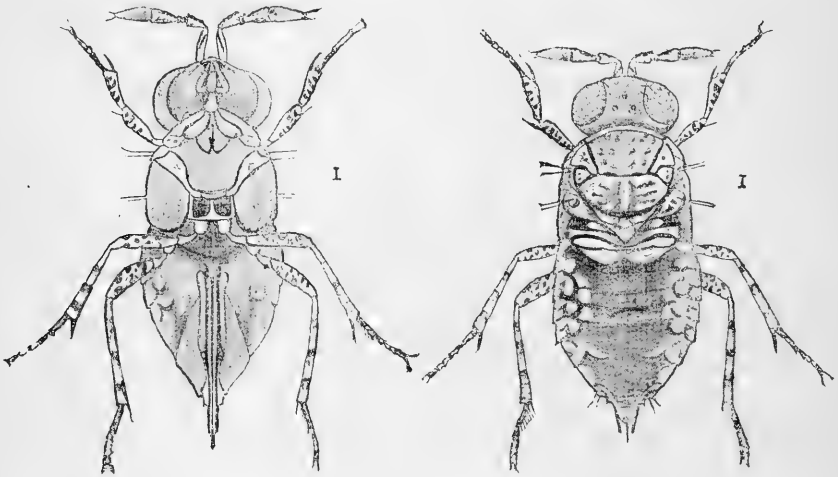

FIG. 6.—*Perissopterus pulchellus*, new species, female; ventral view at left, dorsal view at right (wings removed)—greatly enlarged (original).

on cottonwood from East Atchison, Mo., sent in by Mr. W. S. Connor, while a single specimen has been reared by Mr. W. G. Johnson, at Champaign, Ill., from a species of *Aspidiotus* on currant, and is now in the collection of the Illinois State Laboratory of Natural History. All the specimens vary somewhat in wing markings, but the general pattern remains the same as that shown at fig. 5 *a*.

Perissopterus mexicanus n. sp. (fig. 5 *b*).

Female.—Length, 0.84 mm.; expanse, 2.3 mm.; greatest breadth of fore-wing, 0.41 mm. Head and thorax closely and finely punctate; eyes smooth; dorsal surface of abdomen faintly shagreened; wing markings of type shown in figure. General color light orange-yellow, without the strong reddish hue and admixture of white seen in *pulchellus*. Pronotum, tegulæ, postscutellum, metascutum, under side of abdomen and

pleura, whitish; mouth-parts also whitish. Antennal scape silvery white, with two oblique black stripes below. Pedicel black at base, the black extending farther forward on the upper side; otherwise silvery white. Ring joints black, third funicle joint concolorous with pedicel; club black at base and tip, with an orange stripe around the middle. All legs white, all femora with four black bands, all tibiæ with three black bands, tibial spurs black. First and second dorsal segments of abdomen blackish, third and fourth yellow, fifth black. Mesoscutum and scutellum with many black dots; those on the scutellum number eight, arranged in two transverse rows; those in the anterior row far apart, and those in the posterior row close together. The two interior spots in the first row and the two outer spots in the second row are piliferous. Dorsum of abdomen black; ovipositor black.

Male.—Closely resembles female, differing only in the genitalia and the smaller size.

Described from three females and two males reared from *Lecanium hesperidum*, *Pseudococcus yuccæ*, and *Ceroplastes* sp. Guadalajara, Mexico: C. H. Tyler Townsend.

Genus APHELINUS Dalman.

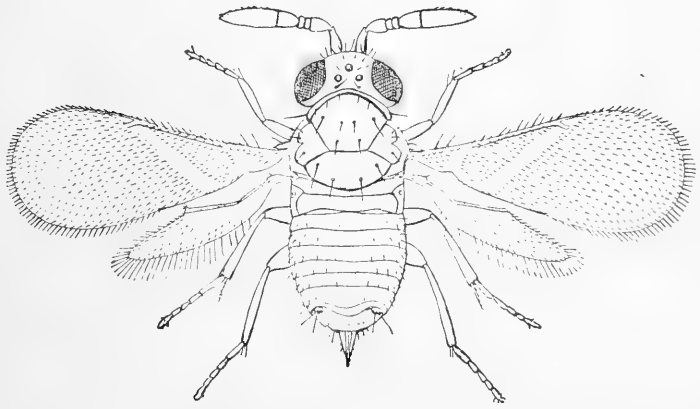

FIG. 7.—*Aphelinus diaspidis* Howard—greatly enlarged (from Insect Life).

Aphelinus Dalman. Sv. Akad. Handl., 1820, 181.
Agonioneurus Westwood. Mag. Nat. Hist., vol. VI, 1833.
Myina Nees. Hymenopterorum Ichneumonibus Affinium, 1834.
Aphelinus Walker (in part). Monographia Chalciditum, London, 1839.
Coccobius Ratzeburg (in part). Ichneumonen der Forst-Insekten, vol. III, 195, 1852.
Eriophilus Haldeman. Proc. Bost. Soc. Nat. Hist., vol. VI, 402, 1860.

In this old and well-known genus the oblique hairless line of the front wings is very distinct. The ovipositor is very slightly extruded, or is entirely hidden. The fringed apical cilia of the fore-wings is very short; the body is robust, eyes naked in the yellow species and hairy

in the black species. The posterior border of the mesoscutellum is rounded and the anterior border is bounded by three straight lines. The antennæ are 6-jointed, scape long and slender, pedicel normal, joints 1 and 2 of the funicle very short, joint 3 about as long as or a little longer than the pedicel, club compact, not jointed, subellipsoidal. The middle tibial spur is very pronounced, mesoscutar parapsides rather small, marginal vein very long, longer than submarginal; stigmal and postmarginal short.

ANALYSIS OF THE SPECIES OF APHELINUS.

Eyes hairy; general color black; pedicel twice as long as thick.
  Head jet black ..... *mali*
  Head bright orange ..... *flaviceps*
Eyes naked; general color yellow; pedicel one and one-half times as long as thick.
  Club twice as long as penultimate joint ..... *mytilaspidis*
  Club thrice as long as penultimate joint.
    Scutellum pointed at base ..... *abnormis*
    Scutellum normal.
      Forewings with only a faint cloud beneath stigma ..... *diaspidis*
      Forewings with a distinct fuscous cloud occupying the whole discal region and accented below stigmal and at its proximal border .. *fuscipennis*

Aphelinus mali (Haldeman).

Eriophilus mali Haldeman. Proc. Boston Soc. Nat. Hist., vol. VI, p. 402, 1860.
Aphelinus mali Howard. Ann. Rep. Dept. Agric., 1880, p. 356.
Blastothrix rosæ Ashmead. Trans. Am. Entom. Soc., vol. XIII, p. 130, 1886.

Female.—Length, 1.2 mm.; expanse, 2.3 mm.; greatest width of fore-wing, 0.41 mm. Pedicel twice as long as thick; club nearly three times as long as penultimate joint; head and thorax smooth, shining; mesoscutum with sparse, irregularly placed, and fine punctures; mesoscutellum very faintly shagreened; abdomen perfectly smooth; mesopleura at tip faintly shagreened, smooth at base; hind coxæ also faintly shagreened; eyes plainly hairy; vertex with rather dense black pile; sparse hairs of thorax black; abdomen ovate, as wide as thorax, concave above. Discal cilia of forewings proximally bordering hairless streak much longer and stouter than those on distal side of streak. Of these proximal cilia there are only two or three irregular rows, the remainder of base of wing being hairless, except immediately below marginal vein, and excepting also the normal bristles arising from the submarginal. General color black, not metallic; base of abdomen, and sometimes apex, yellow-brown; antennæ honey yellow. Front and middle femora and middle and hind tibiæ, dark brown, lighter at extremities; front tibiæ slightly dusky at base, but in general sordid yellow. Hind femora pale sordid yellow; all tarsi light; wings hyaline; submarginal vein dark brown, marginal much lighter.

Male.—Similar to female, slightly smaller; abdomen acuminate. Proximal cilia bordering hairless streak of fore-wings, consisting of a single row for a greater part of the wing width.

Redescribed from thirty-one male and female specimens reared by the writer from *Schizoneura lanigera*, at Washington, D. C., February 15 and September 20, 1879 (previously reared from the same species by Haldeman in Pennsylvania, Walsh in Illinois, and Riley in Missouri); by F. M. Webster from *Glyphina eragrostidis*, at La Fayette, Ind., September 6–10, 1885; by the same observer from *Aphis brassicæ*, on turnip; by T. A. Williams, at Lincoln, Neb., from *Pemphigus fraxinifolii*, June 10, 1890; and by the same observer from *Aphis monardæ* at Ashland, Nebr., May 24, 1890. Mr. Ashmead's specimens, which he described under the name of *Blastothrix rosæ*, were reared from *Siphonophora rosæ* in April, 1881, at Jacksonville, Fla.

Aphelinus flaviceps n. sp.

Male.—Belongs to the same group as *A. mali*, which it resembles in the proportions of the antennal joints and in the hairy eyes. It is a species of the same general size, and differs from *A. mali* in the following particulars: The pile of the head is much less conspicuous, and is yellowish instead of black; the mesoscutum is more or less thickly punctate, the punctures being arranged in rows; the mesoscutellum is more coarsely, though still finely, shagreened; mesopleura plainly shagreened over entire surface, not smooth on basal half; hind coxæ granulate. Entire thorax black; entire head uniform orange-yellow, except occiput, which has a dark transverse streak. Abdomen dark in the middle above; for the rest concolorous with head. All legs and antennæ uniform orange-yellow. Wings hyaline, veins light, the cilia at proximal border of hairless streak larger than those at apical border (more than twice as long and much stouter); they are irregularly placed, and on the lower half of the wing form approximately two rows.

Described from one male specimen collected in the Santa Cruz Mountains, California, by A. Koebele, in May. Probably parasitic on some Aphidid.

Aphelinus mytilaspidis Le Baron.

Aphelinus mytilaspidis Le Baron. American Entomologist, vol. II (1870), p. 360.

Female.—Length, 0.64 mm.; expanse, 1.28 mm.; greatest width of fore-wing, 0.22. Eyes naked; pedicel of antennæ one and a half times as long as thick, club twice as long as penultimate joint; thorax smooth, impunctate; abdomen ovate, as wide as thorax. Cilia at proximal border of hairless streak of forewings larger than those at apical border, but hardly twice as long. There are at least seven irregular rows, and they extend back nearly to base of wing, with slight interruption at two-thirds distance from tegula to hind border of hairless streak. General color bright lemon-yellow; scape of pedicel and sometimes funicle joints 1 and 2 of antennæ dusky; eyes blackish, ocelli carmine, mandibles brown, all legs yellow, wing veins bright yellow; wings perfectly hyaline.

Male.—Similar to female, slightly smaller; antennal club somewhat truncate at tip.

Described from many male and female specimens, mostly reared at the Department of Agriculture in 1879 and 1880. The species was reared by Le Baron from *Mytilaspis pomorum* Bouché, in Illinois; by Riley from the same species in Missouri; and it is probably the species which caused the round holes observed in this scale by Dr. Fitch in New York. At the Department of Agriculture it has been reared from *Mytilaspis pomorum* from Illinois and the District of Columbia; from *Chionaspis pinifolii* (District of Columbia), and from the same species by Riley in Missouri; and from *Diaspis carueli* Targioni on juniper.

Aphelinus abnormis Howard.

Aphelinus abnormis Howard. Ann. Rep. Dept. Agric., 1880, p. 355.

Female.—Length, 0.55 mm.; expanse, 1.4 mm.; greatest width of fore-wing, 0.23 mm. General proportions as with *A. mytilaspidis*, from which it differs only in the following respects: The scutellum is pointed anteriorly, seemingly entering a reentering angle on the base of mesoscutum; antennal club three times as long as penultimate joint; color, light lemon-yellow, lighter than the preceding species; antennæ dusky; legs with yellowish femora and dusky tibiæ and tarsi; wings perfectly clear; veins transparent.

Described from one female specimen reared from *Mytilaspis pomorum* on *Salix caprœa*, District of Columbia. No other specimen of this peculiar form has ever been found. There is a possibility that it may be simply a dwarfed and distorted specimen of *A. mytilaspidis*.

Aphelinus diaspidis Howard (fig. 7).

Aphelinus diaspidis Howard. Ann. Rep. Dept. Agric., 1880, p. 355.

Female.—Length, 0.78 mm.; expanse, 1.9 mm.; greatest width of fore-wing, 0.27 mm. Differs at once from *A. abnormis* in the normal character of the scutellum and from *A. mytilaspidis* in the fact that the club is three times as long as the penultimate joint, instead of twice as long. It further differs from *A. mytilaspidis* in the following particulars: The entire space proximad of hairless line of forewing is densely ciliated, the cilia but slightly larger than those distad of this line. At the abrupt upward bend of the submarginal into the marginal a triangular clear space occurs, the distal side of which is curved, the apex touching the beginning of the marginal vein. The forewings have a delicate fuscous patch bending outward from below the stigma and covering the entire disk from that point back to the triangular clear space. The incision between the penultimate joint of the antennæ and the club is not well marked, joint 5 apparently forming part of the club. Color dull, rather dark yellow; eyes black, ocelli very dark red, antennæ dusky, darker at tip; a narrow dark transverse line on the occiput

behind the eyes. Femora and tibiæ fuscous; tarsi nearly white; wing veins fuscous. Abdominal segments 1 to 5 each with a dusky transverse dorsal band interrupted toward the middle; abdomen subovate, somewhat truncate at tip; ovipositor slightly exserted.

Male.—Unknown.

Described from twelve female specimens reared from *Diaspis rosæ* from Fort George, Fla., and the same species collected at Santa Barbara, Cal., and from the same species collected in the District of Columbia. All specimens were reared in February. Professor Riley reared nine females from a *Mytilaspis* on an orchid, an undetermined species of *Dycaste* from Japan, received February 6, 1874, from Mr. George Thurber, of The American Agriculturist.

Aphelinus fuscipennis Howard.

Aphelinus fuscipennis Howard. Annual Rep. Dept. Agric., 1880, p. 356.

Female.—Length, 0.6 mm.; expanse, 1.3 mm.; greatest width of fore-wing, 0.2 mm. Closely resembles *A. diaspidis*, the differences, aside from its smaller size and the more pronounced infuscation of the wing, being purely colorational. General color, dull honey yellow; antennæ fuscous, almost black at tip; eyes blackish; ocelli dark crimson; a distinct transverse black band on the occiput behind the eyes; the scutellum dusky at tip; abdomen with five dusky lateral transverse bands; legs and wing veins honey yellow; fore-wings with an indefinite fuscous patch below stigma and another well-defined, darker, somewhat crescent-shaped streak near the base, bounded by the basal clear space.

Male.—Closely resembles the female, but is slenderer and in general darker in color.

Described from many female specimens and comparatively few males, reared from *Aspidiotus perniciosus* at San Jose, Cal.; Los Angeles, Cal.; San Francisco, Cal.; New Brunswick, N. J., and Riverside, Md.; from *Chionaspis euonymi* from Fort George, Fla.; from *Mytilaspis gloverii* in hothouses in the District of Columbia, and from *Mytilaspis pomorum* on horse-chestnut in the District of Columbia. Professor Berlese has reared this species in Italy from an *Aspidiotus* on *Acacia longifolia*.

Genus **PLASTOCHARIS** Foerster.

Plastocharis Foerster. Hymenopterologische Studien, Heft. II, 145, 1856.
Tryphasius Foerster. Loc. cit., 83.
Thysanus Walker. Ann. Nat. Hist., 1839, p. 234. (Changed by Foerster on account of preoccupation.)

The best description of this genus is given by Foerster in his Kleine Monographien, page 68. It is not known to occur in this country. The male antennæ have one ring joint and a very long flagellar club. The female antennæ have three ring joints and a shorter club. The middle tibiæ have a long spur and the tarsi are 5-jointed. The base of

the wing is hairless, and the oblique line is therefore lacking. The forewings on their last third have a very long fringe of hairs, their length not equaling the wing breadth. Basal half of forewing brown-

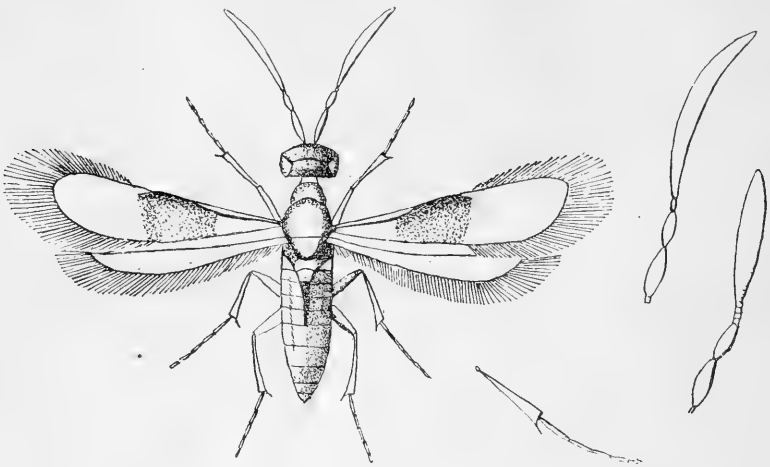

FIG. 8.—*Plastocharis ater* Walker: female; enlarged middle tarsus and male and female antennæ at right—greatly enlarged (redrawn from Haliday in Walker's notes).

ish. Hind-wings with very long marginal cilia, extending around upon the fore margin nearly to the vein; ovipositor is not extruded (fig. 8).

Genus ENCARSIA Foerster.

Encarsia Foerster, Kleine Monographien, 1878, pp. 65, 66.

The characters briefly given by Foerster include the following:

Head not so broad as the thorax; side of the ocelli about as far from the middle of the ocellus as from the border of the compound eyes. Antennæ 8-jointed, flagellar joints of equal length and cylindrical, last two closely joined. Mesoscutum broad, with sharp parapsidal furrows, scutellum very strongly developed, broad, almost semicircular. The abdomen as long but not as broad as the thorax and broadly oval pointed. Tarsi 5-jointed. The thickly ciliated wing has the submarginal not much longer than the marginal, the postmarginal wanting, and the stigmal very short and forming a considerable angle with the costa. The hairless line is wanting; the hind border of the hind-wings with long cilia.

But one European species, *E. tricolor*, is known.

ANALYSIS OF THE SPECIES OF ENCARSIA.

First funicle joint not swollen.

Pedicel one-third longer than first funicle joint; joint 2 considerably longer than joint 1 ..... *luteola*

Pedicel considerably shorter than first funicle joint; joint 2 equal in length to joint 1 ..... *coquilletti*

First funicle joint somewhat swollen, longer and broader than pedicel, and broader and slightly stouter than second funicle joint ..... *angelica*

Encarsia luteola n. sp.

Female.—Length, 0.63 mm.; expanse, 1.3 mm.; greatest width of fore-wing, 0.19 mm. Pedicel stout, two-thirds as broad as long, and about one-third longer than first funicle joint. Joint 2 of funicle one-third longer than joint 1; joint 3 twice as long as joint 1; joints 4 and 5 as long as 3; terminal joint a trifle longer; all joints well separated, subcylindrical, increasing very slightly in width to club. Thorax without perceptible sculpture. Eyes dark, ocelli coral red, wings perfectly hyaline, general color yellowish. Vertex with black transverse line between the eyes. Upper portion of head somewhat orange, face lighter. Dorsum of thorax dark orange, becoming somewhat dusky at sides, particularly at insertion of wings; abdomen light pale yellow. All legs and antennæ uniform light yellow, club of antennæ slightly dusky. Submarginal vein fuscous, marginal and stigmal faintly yellowish.

Described from one female specimen reared August 14, 1881, from *Aleyrodes* at Washington, D. C.; food-plant unknown.

Encarsia coquilletti n. sp. (fig. 9).

Female.—Length, 0.88 mm.; expanse, 1.7 mm.; greatest width of fore-wing, 0.27 mm. Pedicel of antennæ twice as long as broad, a little more than half as long as and about as broad as joint 1 of funicle; remaining joints of funicle subequal in length, slightly rounded at extremities, and slightly flattened laterally. Dorsum of thorax faintly shagreened; abdomen smooth; abdomen broadly ovate. Eyes black, ocelli reddish, wings faintly dusky on basal half, general color black; joints between segments of abdomen lighter; all tibiæ and tarsi dusky, femora banded in the middle with black, trochanters pallid, antennal scape dark brown, funicle light brown.

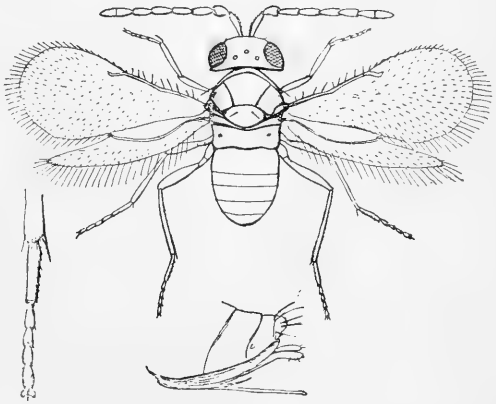

FIG. 9.—*Encarsia coquilletti* Howard: male; female genitalia below; enlarged middle tarsus at left—greatly enlarged (original).

Male.—Differs from the female in not having the abdomen broadly ovate, wings perfectly hyaline, legs all slightly fuscous, and entire abdomen yellow or light brown.

Described from five females and two males reared by Mr. D. W. Coquillett, at Los Angeles, Cal., from *Aleyrodes* on *Sonchus*, September 18–21.

Encarsia angelica n. sp.

Male.—Length, 0.74 mm.; expanse, 1.7 mm.; greatest width of forewing, 0.25 mm. Pedicel as broad as long, less than half as long as joint 1 of funicle; funicle joint 1 as wide as or slightly wider than pedicel, rounded at base, more truncate at tip, appearing swollen in comparison with next joint; joint 2 a little longer than joint 1 and narrower, cylindrical; joints, 3, 4, and 5 each a trifle longer than its predecessor, otherwise resembling it. Terminal joint a little shorter than its predecessor, rounded at base and tapering to somewhat pointed tip. Thorax and abdomen smooth. General color brownish yellow, darker on pronotum and anterior portion of mesoscutum at sides of parapsides and metanotum, and on dorsum of abdomen; a dark line between the eyes and under ocelli. Tegulæ brown; all legs uniform pale straw-yellow.

Described from one male specimen reared from *Aleyrodes* on willow September 17, at Los Angeles, Cal., by Mr. D. W. Coquillett.

Genus **ASPIDIOTIPHAGUS** Howard.

Aspidiotiphagus Howard. Insect Life, vol. VI, p. 230, 1894.

Female.—Antennæ 8-jointed; scape long, slender; pedicel a little longer than its apical width; funicle joints 1, 2 and 3 increasing in width, but each approximating pedicel in length; club long, distinctly 3-jointed, basal joint shortest, apical joints subequal, terminal joint pointed. Lateral ocelli equidistant from each other and margin of compound eyes. Parapsides of mesoscutum widely separated, very narrow posteriorly, broadening out rapidly toward tegulæ; mesoscutellum like that of *Aphelinus*, its scapulæ longitudinally elongate and extending forward to lateral widening of the parapsides; metanotum very narrow. Abdomen short, broadly sessile and broadly rounded at tip. Spur of middle tibiæ very slender, as long as the short first tarsal joint. Forewings long, narrow; submarginal and marginal veins subequal in length; postmarginal lacking; stigmal very slight and parallel with costa, situated at half the wing length and exactly opposite to the termination of thickening of hinder margin of wing, this being also the widest point of the wing; cilia of wing surface rather sparse, a clear rounded space immediately below stigma, and a narrow clear line around margin; marginal vein bristly; marginal cilia very long, longer than wing width, those on costal margin just beyond stigma nearly as long as those on hind margin. Hind-wings very narrow, with long marginal cilia and but one row of discal cilia on outer third; marginal vein ending abruptly and extending up apparently beyond costa.

Differs from *Coccophagus* in wings and from *Encarsia* in antennæ and wings.

Aspidiotiphagus citrinus (Craw). (fig. 10).

Coccophagus citrinus Craw. Destructive Insects, Sacramento, Cal., 1891.
Aspidiotiphagus citrinus Howard. Insect Life, vol. vi, p. 234, 1891.

Female.—Length, 0.58 mm.; expanse, 1.16 mm.; greatest width of fore-wing, 0.09 mm. Antennæ light yellow-brown; eyes black, ocelli bright red; head yellow; occiput dark brown; pronotum dark brown; mesonotum yellow; metanotum yellow-brown; abdomen brown; legs uniformly dusky yellow; wings with marginal vein dark fuscous, and a broad fuscous band extending directly across wing from marginal vein as a base. Spiracular hairs on pre-anal abdominal joint very long. Thorax somewhat wider than head or abdomen, these being subequal in width.

Redescribed from fourteen female specimens reared January 18 and 24, February 2, and March 13, 1889, by Mr. D. W. Coquillett from

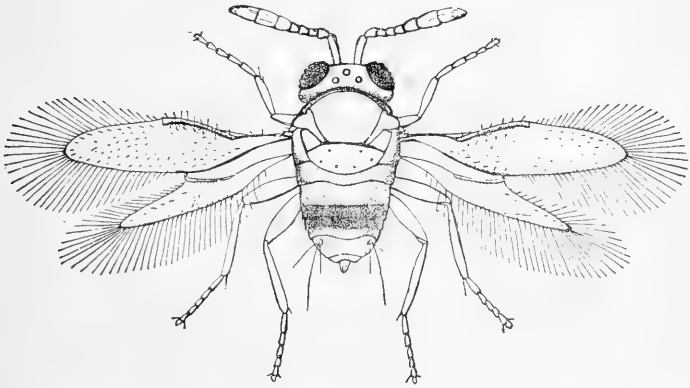

FIG. 10.—*Aspidiotiphagus citrinus* (Craw.)—greatly enlarged (from Insect Life).

Aspidiotus aurantii Maskell, var. *citrinus*, from San Gabriel, Cal. Mr. G. W. Johnson has also sent me six specimens reared at the Illinois State Laboratory of Natural History from *Aspidiotus ficus* occurring on *Citrus decumana* in the university greenhouse. Professor Berlese has reared this species in Italy from an *Aspidiotus* on *Acacia longifolia* and from *Diaspis rosæ*.

Genus COCCOPHAGUS Westwood.

Coccophagus Westwood. Philosoph. Mag., vol. III, 1833.
Aphelinus Walker (in part). Monographia Chalciditum, London, 1839.
Coccobius Ratzeburg (in part). Ichneumonen der Forst-Insekten, vol. III, p. 195, 1852.

Ratzeburg's genus *Coccobius* includes, as will be seen from the synonymical list, certain species of *Coccophagus* and certain species of *Aphelinus* as well. His antennal figure is that of *Aphelinus*, but his descriptions include species which apparently belong to *Coccophagus*, notably *C. notatus*.

In this genus the antennæ are 8-jointed, the scape rather short and stout; pedicel one-third the length of the scape and about the same

thickness. Joints 1, 2 and 3 of the funicle increase very slightly or not at all in thickness and decrease slightly in length. Club very plainly 3-jointed, a little broader at middle than at base, pointed or rounded at tip, and rather longer than funicle joints 2 and 3 together. With the male the club is less compact and is narrower than with the female. Mesoscutum large, posterior border with a slight re-entering angle. Parapsidal sutures curved, mesoscutellum about as long as broad, rounded behind; wings equally hairy, except at immediate base. No hairless line; marginal vein as long as or longer than submarginal; postmarginal lacking; stigmal very short. Middle tibial spur strong, not as long as first tarsal joint. Eyes invariably hairy.

The species of *Coccophagus*, with the exception of *C. ochraceus*, are all black in color, and frequently with a portion of the mesoscutellum and metanotum bright orange or yellow. With certain species the female

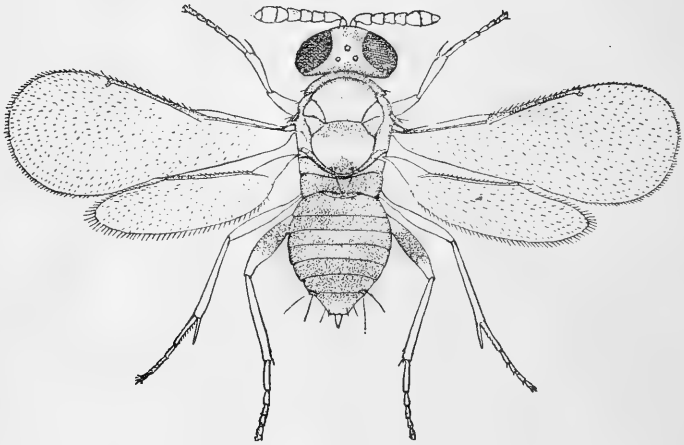

FIG. 11.—*Coccophagus lunulatus* Howard—greatly enlarged (from Insect Life).

has the scutellum partly yellow, while the male is entirely black. Of the sixteen species catalogued by Cresson, *annulipes* Ashmead, as there stated, belongs to the encyrtine genus *Aphycus; brunneus* Provancher and *compressicornis* Provancher do not belong to this subfamily, but probably to the Tetrastichinæ, while *pallipes* Provancher belongs to *Sympiesis*. Of the remaining species Fitch's *lecanii* will hold, and Ashmead's *flavoscutellum* and the writer's *vividus* are synonymical, and Ashmead's species has priority. There remain eight of the writer's species, certain of which have been thrown together after studying more abundant material, as will appear in the following pages. To these he has since added *californicus* (Insect Life, vol. I, p. 269), *aurantii* (loc. cit., vol. VI, p. 231), and *lunulatus* (loc. cit., vol. VI, p. 233). Of these *aurantii* should be placed in *Prospalta*, as indicated in Insect Life (vol. VII, p. 7.)

ANALYSIS OF THE SPECIES OF COCCOPHAGUS.

Females.

Wings hyaline.
- General color dark honey-yellow ..... *ochraceus*
- General color black.
  - Hind border of mesoscutum with a band of yellow; scutellum entirely black ..... *scutatus*
  - Hind border of scutum black; scutellum more or less yellow.
    - Head rather coarsely punctulate; apical two-fifths of scutellum yellow, except for black spot at tip ..... *lunulatus*
    - Head not coarsely punctulate.
      - Scutellum with a narrow but complete marginal yellow band. *californicus*
      - Scutellum with apical half yellow; tegulæ black.
        - Punctures of scutum arranged in longitudinal rows; front and middle tibiæ yellow ..... *lecanii*
        - Not so arranged; all tibiæ dark ..... *cognatus*
      - Scutellum yellow only at tip; all tibiæ brown, yellow at either end; tegulæ black ..... *fraternus*
      - Nearly all of scutellum and postscutellum yellow; tegulæ brown. *flavoscutellum*
  - Scutellum black; face yellow; punctation of mesonotum nearly obsolete *flavifrons*
  - Body entirely black; mesonotum with sparse round punctures, a regular row around hind border of scutum ..... *immaculatus*

Wings dusky; body uniformly purplish black ..... *purpureus*

Males.

Entire body black.
- A regular row of round punctures bordering hind edge of mesonotum. *immaculatus*
- Mesoscutum with sparse punctures, but without such a regular row.
  - Tegulæ brown; all tibiæ and tarsi yellow; hind tibiæ occasionally with dusky patch near base ..... *flavoscutellum, lecanii*
  - Tegulæ black; all tibiæ dark brown in middle, whitish at either end. *fraternus*

Mesoscutellum tipped with yellow.
- General color, brown; mesoscutum irregularly but sparsely punctate ... *cognatus*
- General color, black; punctation nearly obsolete ..... *flavifrons*

Scutellum black; mesoscutum with terminal yellow bands ..... *scutatus*

General color honey-yellow ..... *ochraceus*

Coccophagus lecanii (Fitch.)

Platygaster lecanii Fitch. Fifth Report Insects of New York (1858), p. 25.

Coccophagus lecanii E. A. Smith. Amer. Nat., 1878, p. 661; Seventh Rep. State Entomologist Illinois, 1878, p. 130.

Coccophagus lecanii (Fitch) Howard. Report Entomologist, Annual Report U. S. Dept. Agr., 1880, pp. 357–358; Howard, Report on the Parasitic Hymenoptera, Island St. Vincent, Journ. Linnæan Soc., Lond., vol. xxv, 1894, p. 97.

Coccophagus ater Howard. Report Entomologist, Annual Report U. S. Dept. Agr., 1880, p. 359.

Female.—Length, 1 mm.; wing expanse, 2.25 mm.; greatest width fore-wings, 0.42 mm. Antennæ as long as the thorax; head, pronotum, and mesoscutum finely and sparsely punctured and furnished with short bristles, punctures of mesoscutum arranged in longitudinal rows.

Mesoscutum also has a fine shagreening. Mesoscutellum and parapsides of mesoscutum very finely shagreened, without larger punctures; abdomen smooth. General color black, shining, tegulæ brown; eyes dark reddish brown; antennæ light brown, with darker longitudinal raised lines on flagellar joints. Hairs of thorax whitish, lighter on mesoscutellum. Last half of mesoscutellum and center of postscutellum bright lemon-yellow. Wing veins dark brown. All femora brown or black, somewhat yellowish at either extremity. All tibiæ straw-yellow, with the exception of the posterior pair, which have a brown annulus near base; all tarsi straw-yellow, with the fifth joint dark brown.

Male.—Averages about half the size of the female; abdomen small, much narrower than thorax; antennæ longer than thorax, scutellum dark.

Described from many male and female specimens. Parasitic upon *Lecanium quercitronis* Fitch, New York; *Pulvinaria innumerabilis*, Illinois, Miss Smith; District of Columbia (Division of Entomology); Cambridge, Mass., W. Trelease; Flatbush, Long Island, New York, J. L. Zabriskie; *Lecanium pruinosum*, Los Angeles, Cal., D. W. Coquillett; *Lecanium persicæ*, Ithaca, N. Y. (Department of Agriculture); *Pseudococcus aceris*, Jamaica Plain, Mass., J. G. Jack; *Lecanium hesperidum*, District of Columbia (Department of Agriculture); Los Angeles, Cal. (Department of Agriculture); *Lecanium* on plum, Medina, Ohio, F. M. Webster.

Coccophagus fraternus Howard.

Coccophagus fraternus Howard. Report Entomologist, Annual Rep. U. S. Dept. Agric., 1880, p. 359.

Coccophagus fuscipes Howard. Report Entomologist, Annual Rep. U. S. Dept. Agric., 1880, p. 359.

Female.—Length, 0.78 mm.; expanse, 2 mm.; greatest width forewings, 0.36 mm. Thoracic punctures much as with *C. lecanii*, but mesoscutum is smoother and the larger punctures are not arranged in longitudinal rows. Thoracic bristles black, except those on mesoscutellum, which are white. Tip of mesoscutellum bright yellow, somewhat orange, dividing line between yellow and black very irregular. Center of postscutellum only slightly yellowish. All coxæ and femora black, whitish at tips. All tibiæ dark brown in middle, whitish at either end.

Male.—Somewhat smaller than female; antennæ longer, club proportionately considerably longer, each of the joints as long as each of the immediately preceding funicle joints. Coloration like that of female, except that the yellow tip of mesoscutellum is wanting.

Described from many female and male specimens. Parasitic upon *Lecanium persicæ*, District of Columbia (Department of Agriculture); Agricultural College, Michigan (A. J. Cook).

Coccophagus cognatus Howard.

Coccophagus cognatus Howard. Report Entomologist, Ann. Rep. U. S. Dept. Agric., 1880, p. 359.

Female.—Length, 1.2 mm.; wing expanse, 2.1 mm.; greatest width of fore-wing, 0.34 mm. Antennæ not quite so long as thorax. General color dark brown, nearly black; last half of mesoscutellum and tip of metascutellum orange-yellow; anterior coxæ, femora, and tibiæ, fuscous; tarsi whitish, last two joints slightly dusky; middle femora and coxæ nearly black, tibiæ somewhat dusky, tarsi as with fore tarsi; hind coxæ, femora, and tibiæ dark, tibiæ as with others.

Male.—Length of body, 0.6 mm.; expanse of wings, 1.4 mm.; greatest breadth of fore-wing, 0.25 mm. Antennæ nearly as long as head and thorax together. General color brown; scutellum and metascutellum just tipped with light yellow-brown. In all other respects resembles the female.

Described from many specimens. Parasitic upon *Lecanium hesperidum*, District of Columbia (Department of Agriculture); *Lecanium* on plum, Bramley, Ontario (J. Fletcher and T. D. A. Cockerell); *Lecanium persicæ*, Lake Shore and Mapleville, Md. (Department of Agriculture).

Coccophagus immaculatus Howard.

Coccophagus immaculatus Howard. Report Entomologist, Annual Rep. U. S. Dept. Agric., 1880, p. 358.

Female.—Length, 1.2 mm.; wing expanse 2.35 mm.; greatest width of fore-wings, 0.47 mm. Antennæ slightly longer than thorax. Mesoscutum and mesoscutellum sparsely furnished with round punctures, of which there is a regular row around hind border of mesoscutum. Between the punctures is a faint shagreening. All hairs blackish, metanotum honey-yellow. General color black; eyes reddish brown, with a yellowish border above; ocelli dark red; antennæ light yellowish brown, with dark brown longitudinal carinæ on each joint except scape and pedicel; mesoscutellum shining black, slightly metallic in some lights; wing veins dark brown; front femora black; middle and hind femora black, except at base, which is whitish; front tibiæ dusky, light at knees; middle and hind tibiæ light yellow; all tarsi whitish, last joint fuscous; front coxæ dark brown, middle and hind coxæ and all trochanters yellowish; ovipositor yellow, sheaths brown.

Male.—Length, 0.9 mm.; wing expanse, 2.3 mm.; greatest width of forewing, 0.43 mm. Antennæ as long as thorax; club compact, the lines separating the joints of the club somewhat oblique. Colors as with female, except that metanotum and all coxæ are black.

Described from three males and three females. Parasitic on *Eriococcus azaleæ*, District of Columbia (Department of Agriculture). The punctured scutellum is unique.

Coccophagus purpureus Ashmead.

Coccophagus purpureus Ashmead. Trans. Am. Ent. Soc., vol. XIII, p. 132, 1886.

Female.—Length, 0.10 inch. Robust and of a uniform purplish black color throughout, including abdomen, coxæ and femora; the surface is very finely punctate, and the tibiæ and tarsi are yellow; wings, except at base, brown.

Captured on gall-berry bushes.

I have not seen this species, but Mr. Ashmead tells me that there is no doubt it is a true *Coccophagus*. It differs from all known species in the infuscated wings.

Coccophagus flavifrons Howard.

Coccophagus flavifrons Howard. Bulletin 5, Bureau Entomology, U. S. Dept. Agric., 1885, p. 25.

Coccophagus koebelei Howard. Bulletin 5, Bureau Entomology, U. S. Dept. Agric., 1885, p. 24.

Female.—Length, 1 mm.; expanse, 2 mm.; greatest width fore-wings, 0.35 mm. Punctation of thorax nearly obsolete. Scutellum perfectly smooth, except for faint shagreening. Hairs black; eyes, clypeus, occiput, abdomen, and dorsum of thorax black, with a bluish metallic luster upon abdomen. Face, antennal scape, all tibiæ, middle femora, honey-yellow; hind femora black at base, yellowish at tip; front femora brownish at base, yellow at tip; tegulæ dark yellow or brown; edge of mesoscutum just above tegulæ, also brown; wing veins fuscous.

Male.—Somewhat smaller; uniform black except tegulæ, which are brownish; antennæ light brown, scape black; all femora black, except at tips; all tibiæ and tarsi yellow; extreme tip of meso- and metascutellum yellowish.

Described from three females and one male. Parasitic upon *Lecanium* sp. on *Pinus australis* (A. Koebele, Department of Agriculture).

Coccophagus flavoscutellum Ashmead.

Coccophagus flavoscutellum Ashmead. Florida Agriculturist, vol. IV (1881), p. 65.

Coccophagus vividus Howard. Bulletin 5, Bureau Entomology, U. S. Dept. Agriculture, 1885, p. 25.

Female.—Length, 1.03 mm.; wing expanse, 1.96 mm.; greatest width of fore-wing, 0.35 mm. General color, shiny black; antennæ light brown, with the customary dark brown longitudinal carinæ; greater part of mesoscutellum and visible portion of metascutellum bright orange-yellow, the line of juncture of the two colors on the mesoscutellum straight and sharp; tegulæ yellow-brown; all coxæ and femora brown, yellow at joints; all tibiæ and tarsi yellow, occasionally a dusky patch near base of hind tibiæ; fifth tarsal joint brown. Entire mesoscutum very finely punctate.

Male.—Length, 0.55 mm.; wing expanse, 1.47 mm.; greatest width of fore-wing, 0.25 mm. Color as in female, except that the tegulæ are brown and the scutellum is black, sometimes yellow at extreme tip.

Redescribed from many male and female specimens. Parasitic upon *Lecanium hesperidum*, Crescent City, Fla., H. G. Hubbard; Jacksonville, Fla., W. H. Ashmead; Los Angeles, Cal., A. Koebele; *Lecanium* sp., New Alameda, Cal., H. W. Turner; *Dactylopius destructor*, District of Columbia, Th. Pergande; *Lecanium* sp., Los Angeles, Cal., D. W. Coquillett; *Lecanium tulipiferæ*, Molino, Fla. (Department of Agriculture); *Pulvinaria* on plum, Florence, S. C. (Department of Agriculture); *Pulvinaria* sp. on *Sullengia*, Rockport, Tex., E. A. Schwarz: *Pulvinaria innumerabilis*, Roslyn, N. Y., L. H. West (Department of Agriculture); *Lecanium* sp. on *Adenostema*, Alameda, Cal., A. Koebele; *Lecanium* sp. on *Arctostaphylos*, Sonoma, Cal., A. Koebele; *Lecanium* sp. on plum, Ottawa County, Ohio, F. M. Webster.

Coccophagus californicus Howard.

Coccophagus californicus Howard. Insect Life, vol. I, p. 269 (March, 1889).

Female.—Length, 1.4 mm.; expanse, 2.1 mm.; greatest width of forewing, 0.39 mm. Abdomen broader than thorax and one-third longer. Pedicel and joints 2 and 3 of funicle subequal in length; joint 1 of funicle one-third longer. Eyes rather more plainly hairy than usual. General color dark brown, nearly black, no punctation visible. Mesoscutellum lighter in color than rest of thorax, except at immediate base, its posterior edge with a narrow band of bright lemon-yellow extending from one lateral angle around the curved border to the opposite lateral angle, of nearly equal width throughout, at its widest portion measuring 0.027 mm.; all coxæ brown; all trochanters yellowish white; all femora brown, yellow at tip; more yellow at tip of front femora, less at tip of middle, and still less at tip of posterior femora; front tibiæ light yellow, very slightly dusky; middle tibiæ entirely light yellow; hind tibiæ yellowish, with a brownish shade near base; all tarsi yellowish white, last joint dusky. Wings hyaline, veins light brown, distinct.

Described from one female specimen reared from a female *Icerya purchasi* at Los Angeles, Cal., July 6, 1887, by Mr. D. W. Coquillett.

Coccophagus lunulatus Howard (fig. 11.)

Coccophagus lunulatus Howard. Insect Life, vol. VI, p. 232 (Feb., 1894).

Female.—Length, 0.93 mm.; expanse, 2 mm.; greatest width of forewing, 0.39 mm. Head rather coarsely punctulate, opaque; mesonotum very finely shagreened, somewhat glistening; mesoscutellum with apical bristles very long; abdomen smooth, shining. General color black; apical three-fifths of mesoscutellum bright orange, with an irregular black spot at tip, and with the dividing line between the orange and black irregular; tegulæ black; antennæ with the scape black and the flagellum dark fuscous; front legs, including coxæ, light orange yellow, considerably lighter than the mesoscutellum; middle and hind coxæ and hind femora black; middle and hind trochanters, tibiæ, and tarsi and

middle femora ligh orange-yellow. Wings hyaline, veins dark brown, marginal cilia very short.

Described from one female reared December 5, 1892, from *Aspidiotus aurantii*, received from D. W. Coquillett, Los Angeles, Cal.

Coccophagus scutatus n. sp.

Female.—Length, 1.6 mm.; expanse, 3.3 mm.; greatest width of fore-wing, 0.58. Punctation of head and mesothorax scaly, more marked on mesoscutum. Thoracic bristles long and sparse, particularly long on hind border of pronotum and border of mesoscutellum. Parapsidal grooves very indistinct. Occiput, metanotum, and abdomen smooth and shining. Wing veins very heavy. General color black, mesoscutellum and postscutellum without a trace of yellow; mesoscutum with broad transverse band of orange extending from tegula to tegula, the anterior border being nearly straight, while posterior border follows the central backward curve of the scutum. Antennæ dusky, legs pale fuscous, coxæ dark, femora with a middle brownish band, middle tibia darker in the middle and hind tibia dark brown on basal half. Wings clear, veins dark brown.

Male.—Rather smaller, but closely resembles female. The mesoscutar band is of a pale orange; the antennæ are lighter in color; the scape yellowish; front and middle legs, with the exception of basal half of coxæ, entirely light lemon-yellow. All of hind coxæ and femora concolorous with other legs, but basal half of hind tibia is nearly black. Lower half of face also somewhat yellowish, particularly along the borders of the antennal groove.

Described from five females and one male reared by A. Koebele in October from a *Kermes* on *Quercus agrifolia* at Los Angeles, Cal. Also nine specimens reared by D. W. Coquillett from the same host at Los Angeles.

Differs from all other species of *Coccophagus* known to me in the possession of the scutal band.

Coccophagus ochraceus n. sp.

Female.—Length, 0.7 mm.; expanse, 1.53 mm.; greatest width of fore-wing, 0.3 mm. Differs at once from all other species of the genus in having the general color ochraceous or dark honey-yellow instead of black. Head and mesonotum very finely and sparsely punctate, also very delicately shagreened. Normal notal hairs blackish; abdomen smooth. General color, as just stated, dark ocher-yellow. Eyes dusky, ocelli dark red. Antennæ yellowish, except pedicel, which is blackish. Mesopleura and terminal segments of abdomen dark brown, nearly black. All legs concolorous with thorax. Wings hyaline, veins uniformly fuscous.

Male.—Punctation of notum a trifle more pronounced than with the female, mesoscutum appearing slightly rugose; antennæ slightly dusky.

Described from three males and one female, reared July, 1887, at Alameda, Cal., by A. Koebele, from *Lecanium* on *Adenostema fasciculatum*.

This species interferes with a suggested generalization made by the writer in a paper entitled "The hairy eyes in Hymenoptera" (Proc. Entom. Soc. Wash., vol. I, p. 195) to the effect that the hairy eyes in the subfamily Aphelininæ are associated with a black color. This holds with the typical genus *Aphelinus*, in which all the yellow species have naked eyes, the two black species (*A. mali* and *A. flaviceps*) having hairy eyes. Having a yellow species of *Coccophagus*, we should expect naked eyes; but here hairiness of the eyes seems to be a generic character.

Genus PROSPALTA Howard.

Prospalta Howard. Insect Life, vol. VII, p. 6, 1894.

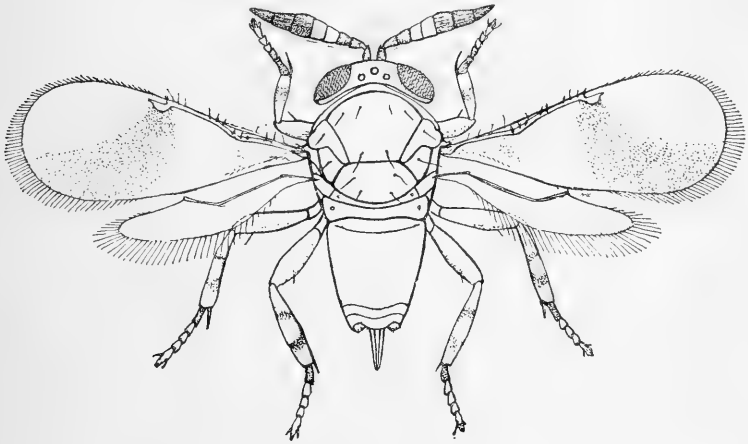

FIG. 12.—*Prospalta murtfeldtii* Howard—greatly enlarged (from Insect Life).

Female.—Anterior wings with no oblique transverse hairless line below stigma. Antennæ 8-jointed; club 3-jointed; all joints subequal in length; first joint of club widest. Head transverse; ocelli at corners of an oblique-angled triangle. Eyes naked. Thorax wider than head; mesoscutar parapsides club-shaped, broadening suddenly on distal side; axillæ extending anteriorly to swelling of parapsides; metascutellum broad and short; legs rather stout; all tarsi short; first joint of hind tarsi only as long as second; first joint of middle and front tarsi longer than second. Ovipositor slightly extruded. Wings broad; submarginal vein reaching nearly to middle of wing; marginal much shorter than submarginal; stigmal very short, its anterior border nearly parallel with costa, its posterior border extending into disk of wing at an angle of 45° with costa; outer margin of fore-wing with rather short cilia; hind margin of hind-wings with somewhat longer cilia. First abdominal joint much the longest; abdomen as a whole equaling thorax in length; whole body tapering gradually from tegulæ to tip of abdomen.

ANALYSIS OF THE SPECIES OF PROSPALTA.

Anterior wings with two fuscous patches; joint 1 of funicle wider than pedicel. *murtfeldtii*

Anterior wings perfectly hyaline; joint 1 of funicle narrower than pedicel.. *aurantii*

Prospalta murtfeldtii Howard (fig. 12).

Prospalta murtfeldtii Howard. Insect Life, vol. VII, p. 6, 1894.

Female.—Length, 0.69 mm.; expanse, 1.7 mm.; greatest width of forewing, 0.3 mm. Joint 1 of funicle wider than pedicel; flagellum gradually widening from base of pedicel to base of club. Surface of body nearly smooth; scutellum slightly shagreened. General color light yellow; mesoscutum with brownish patch covering entire disk; mesoscutellum with two large brown patches, one each side of middle line; axillæ each with a brown patch; metanotum brownish; base of abdomen brown; tip of abdomen also brown; antennæ brown, with the exception of joints 2 and 3 of the funicle, which are whitish; all coxæ and femora light honey-yellow, except that hind femora are dusky at base; front tibiæ with a dusky ring near middle; first and second tarsal joints of forelegs dusky; middle and hind tibiæ each with two dusky bands; first tarsal joint of middle and hind legs dusky; wings hyaline with a fuscous basal patch, and a triangular median fuscous patch with its apex at stigmal vein and its base reaching somewhat less than half of outer hind margin; entire disk of wing densely, finely, and uniformly ciliate; apical spur of tibiæ rather short. Hind-wings with two rows of discal cilia and an interrupted third row on outer third. Hind marginal cilia somewhat longer than wing width.

Described from five balsam-mounted female specimens reared by Miss Mary E. Murtfeldt, at Kirkwood, Mo., from *Aspidiotus uvæ*. Received November 4, 1888.

Since the original description was published I have received a series of thirteen specimens of this insect from Mr. W. G. Johnson, of the State Laboratory of Natural History, at Champaign, Ill. Eleven of this series Mr. Johnson reared from a new species of *Aspidiotus* on cherry twigs, and the other two from a new species of *Aspidiotus* on currant canes, both at Champaign, Ill. The specimens received from Mr. Johnson were all mounted dry, on tags, while the type specimens from Miss Murtfeldt were mounted in balsam. It becomes apparent that Miss Murtfeldt's specimens must have been mounted very soon after they issued from the host insect. The colors are lighter, in general, than those of the matured and dried specimens. The second funicle joint of the antennæ is dusky, like the first funicle joint, and not white, like the third. The general color of the thorax, instead of being yellow, is dark brown. The basal joints of the abdomen are yellowish, with the tip brown. The obvious conclusion is that all these parasites should be allowed to mature in color before being mounted in balsam.

Prospalta aurantii (Howard) (fig.13).

Coccophagus aurantii Howard. Insect Life, vol. VI, p. 231, 1894.

Female.—Length, 0.7 mm.; expanse, 1.16 mm.; greatest width of fore-wing, 0.18 mm. Joint 1 of funicle shorter and narrower than pedicel and than joint 2, which is subequal to pedicel in length and width, joint 3 shorter than joint 2. Surface of thorax smooth. General color, light brownish yellow; occipital line, margin of pronotum and a median stripe on mesoscutum, scapulæ, outer edge of metanotum, abdomen, especially lateral margin, darker; antennæ and legs light fuscous; eyes black, ocelli red; wings hyaline, veins slightly dusky. Fore-wings with disk densely, finely, and uniformly ciliate, costal margin with very short marginal cilia beginning at stigma, growing gradually longer at tip of wing and on lower outer margin becoming half the width of wing; broadest portion of wing beyond stigma; hind-wings as with preceding species.

Described from two female specimens reared May 9, 1887, by D. W. Coquillett from *Aspidiotus aurantii*, var. *citrinus*, from San Gabriel, Cal.

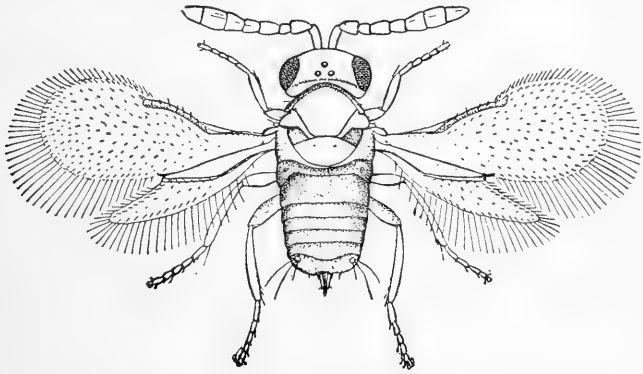

FIG. 13.—*Prospalta aurantii* (Howard)—greatly enlarged (from Insect Life).

Specimens of this species occur in the collection of the Department of Agriculture, reared from the following species of Coccidæ: *Aspidiotus ancylus* Putn. var., on linden, District of Columbia; *Mytilaspis citricola* Pack. on orange, Florida; *Aspidiotus pini* Comst. on *Pinus rigida*, Ithaca, N. Y.; *Mytilaspis albus*, var. *concolor* Ckll., Cockerell, Las Cruces, N. Mex.; *Mytilaspis eucalypti* Crawford MS., Adelaide, South Australia, October 5.

Mr. W. G. Johnson has also sent me from the collection of the Illinois State Laboratory of Natural History at Champaign, Ill., a large series of this species reared from a species of *Chionaspis* on an undetermined food-plant (probably introduced) growing on the university campus. Professor Berlese has also sent me specimens of this species reared in Italy from *Aspidiotus ederæ* and from *Leucaspis pinifoliæ* on *Pinus canariensis*.

The figure of this insect in Insect Life (reproduced above) is not colorational.

The extraordinary geographical range, as indicated by this summary of the specimens at hand, would seem to indicate the possibility that this species is originally an inhabitant of Europe, and that it has been introduced into the United States and Australia. It is evidently a very important species. It is the so-called "golden chalcid" referred to in California reports.

Genus ABLERUS Howard.

Ablerus Howard. Insect Life, vol. VII, p. 7, 1894.

Female.—Fore-wings with no transverse hairless streak below stigma. Antennæ apparently only 7-jointed, club appearing unjointed; antennæ simple, slightly clavate; scape slender; pedicel as long as, or slightly longer than, funicle joint 1; funicle joints 1, 2, and 4 subequal in length, 3 rather shorter; club as long as three last funicle joints together, furnished with two minute papillar projections at tip; mesoscutar parapsides clavate, but not broadening suddenly into a club; mesoscutellum transverse; abdomen semiovate; ovipositor extruded for more than half the length of abdomen. Wings short, narrow; marginal vein nearly as long as submarginal; stigmal long, slender, one-third length of marginal, squarely truncate at tip, extending at a very slight angle into disk of wing; marginal vein with three principal bristles, submarginal with one; cilia of border of wings as with Prospalta; hind border of fore-wings with a longitudinal hairless streak and a slight fold extending from base of wing nearly to middle; thickening of anal margin opposite tip of marginal vein of hind-wings seems to extend forward into this fold; marginal vein of hind-wings with closely set row of minute bristles. First tarsal joint of all legs as long as two succeeding joints together. Middle tibial spur as long as corresponding first tarsal joint.

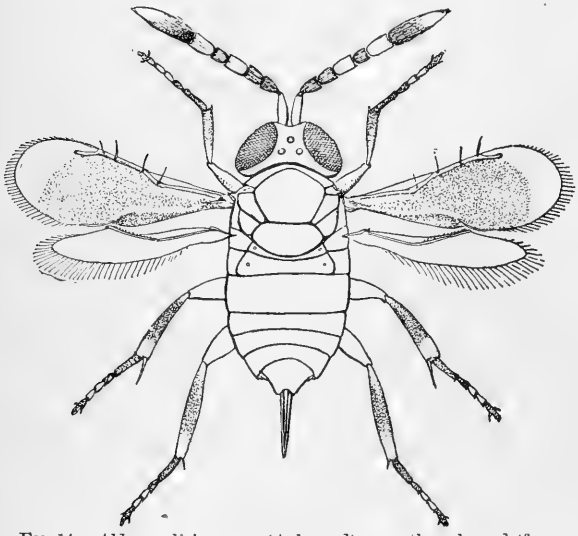

FIG. 14.—*Ablerus clisiocampæ* (Ashmead)—greatly enlarged (from Insect Life).

Ablerus clisiocampæ (Ashmead) (fig. 14).

Centrodora clisiocampæ Ashm., Proc. Entom. Soc. Washington, vol. III, p. 10 (1894).

Female.—Length, exclusive of ovipositor, 0.7 mm.; ovipositor, 0.18 mm.; expanse, 1.5 mm.; greatest width of fore-wing, 0.19 mm. Hairs of

anal spiracle nearly as long as ovipositor. General color black, somewhat metallic, notal sclerites of thorax having a greenish luster, while abdomen appears bluish; antennæ black, with funicle joints 2 and 4 silvery white, and apical three-fourths of club light brown, with a somewhat silvery tinge. Head in life, and shortly after the insect has issued, whitish, with occiput yellow-brown and occipital line black; brown patch including ocelli. Eyes bright red. In dry mounts the head shrivels considerably and becomes light brown in color. Legs dark brown; all tibiæ with a silvery white distal apex. Spurs of middle tibiæ black; tarsal joints 1, 2 and 5 dark brown or black; 3 and 4 whitish. Fore-wings with proximal three-fourths deeply and uniformly infuscated, except two light longitudinal streaks near base; apical one-fourth hyaline; discal cilia very minute, but closely placed; sparse, however, toward distal anal portion and toward base of wing.

Redescribed from ten freshly issued females reared July 6 and 7, 1894, from female specimens of *Chionaspis furfurus*, District of Columbia. Mr. W. G. Johnson has also reared two females from a species of *Aspidiotus* on pear and apple at Champaign, Ill.

In view of these rearings, as well as from the well-known and quite uniform host habit of the group, it becomes probable that Mr. Ashmead's type came from a scale insect in the near vicinity of or perhaps hidden by the Clisiocampa eggs from which he thought he reared it.

PHYSCUS new genus.

Type: *Coccophagus varicornis* Howard.

Female.—Antennæ 7-jointed; inserted at border of clypeus; scape slender; pedicel as long as first funicle joint; second and third funicle joints subequal and each longer than joint 1; club long, ovate, acute, 2-jointed; joint of division before middle. Eyes hairy. Mesoscutar parapsides very narrow; axillæ also narrow; scutellum nearly as long as broad. Discal cilia of fore-wings uniform in distribution, but those proximad of stigma shorter and considerably more delicate than those distad; marginal vein about as long as submarginal; stigmal short, but with a well-defined neck and with a rounded knob; radial angle narrow. Marginal cilia rather short; discal cilia of hind-wing very delicate and rather sparse. First tarsal joint of front and hind legs as long as two following joints; first tarsal joint of middle legs as long as three following joints; middle tibial spur long. Ovipositor slightly extruded.

Male.—No fresh or balsam-mounted males are at hand, and characters can not be studied from the poor material which we have.

Physcus varicornis (Howard).

Coccophagus varicornis Howard. Ann. Rept. Dept. Agr. 1880, p. 360.

Female.—Length, 0.7 mm.; expanse, 1.4 mm.; greatest width of fore-wing, 0.25 mm. Mesonotum very faintly longitudinally shagreened,

nearly smooth, shining; tegulæ, pleura, and abdomen smooth. Wings hyaline. General color glistening black; antennal scape dusky; pedicel nearly white; first funicle joint dark brown; joints 2 and 3 nearly white, somewhat yellowish; club light brown; mesopostscutellum nearly white; all coxæ black; trochanters nearly white; all femora and tibiæ black or dark brown, lighter at extremities; tarsi all nearly white, including terminal joints; pile on sides of abdomen and hind femora white, showing distinctly against the black surface.

Described from one female specimen, reared March 1, from *Aspidiotus ancylus* on linden, District of Columbia. There is also a large series of specimens of this species in the National Museum collection reared from *Chionaspis quercus*, at Alameda, Cal., by A. Koebele, in August. Among the series is a number of males, but none are in condition for description. Such antennal fragments as remain, however, show that the antennæ are probably of a uniform brown color. Mr. W. G. Johnson has also sent me from the State Laboratory of Natural History at Champaign, Ill., a series of five specimens reared from his manuscript *Chionaspis americana* on elm.

TECHNICAL SERIES No. 2.

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THE

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AND

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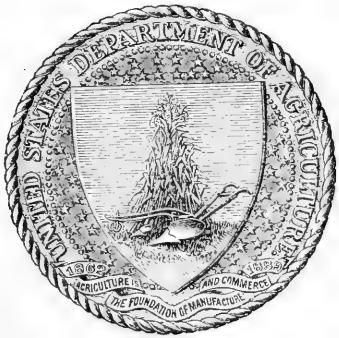
A CONSIDERATION OF SOME NORTH AMERICAN PHYTOPHAGIC EURYTOMINÆ.

BY

L. O. HOWARD,

ENTOMOLOGIST.



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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., February 5, 1896.

SIR: I have the honor to submit for publication the second number of the technical series of bulletins of this office, intended especially for working entomologists, and to be distributed also to learned societies and to periodicals and libraries. The phytophagic Eurytominæ here considered, mainly from the classificatory standpoint, work in the stems of grasses and small grains and in the seeds of grapes.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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ON SOME AMERICAN PHYTOPHAGIC EURYTOMINÆ.

By L. O. Howard.

[illegible] when Prof. F. M. Webster, then a field agent of this division, [illegible]ged in studying certain grain-stalk and grass-stalk insects in Indiana and Ohio, and at about the time when he succeeded in securing the material upon which Dr. Riley established, with his assistance, the fact of dimorphism and alternation of generations of *Isosoma tritici* and *I. grande*, he collected and reared several other species of *Isosoma*, and a little later Mr. Koebele, in California, also an agent of the division, reared several additional species. At that time the writer drew up a rather careful paper on the genus as it was then understood, characterizing all the new forms, and had competent figures of the most important species prepared. The manuscript was then laid aside in the hope that further facts would be ascertained concerning the life history of some of the species which would render the account more complete. Other matters have interfered, however, with the proposed studies, and as the importance of placing the facts already collected upon record and of describing and naming the new forms seems great, the whole subject has been carefully gone over again in the light of recent papers which have been published (especially by Mr. Ashmead), and which involve certain generic changes in the subfamily Eurytominæ, and the results are presented herewith. The writer has included in his account only the species which have been reared or of which we know the habits with some certainty. There are several additional species in Mr. Ashmead's collection and in the collection of the National Museum, but we do not know their specific habits, and they are omitted from present consideration on that account.

The species here treated are included in five genera, the females of which may be separated by the following table:

ANALYSIS OF GENERA.

Females.

Metathorax much lengthened.
- Metanotum sloping, rounded behind ..... *Isosoma*
- Metanotum quadrate, abruptly truncate behind ..... *Isosomorpha*

Metathorax not lengthened.
- Postmarginal vein longer than stigmal, but not twice as long.
  - Parapsidal furrows obliterated posteriorly ..... *Decatomidea*
  - Parapsidal furrows complete, distinct ..... *Eurytomocharis*
- Postmarginal vein twice as long as stigmal ..... *Evoxysoma*

Genus ISOSOMA Walker.

There is no longer any question as to the phytophagic habits of Walker's genus *Isosoma*, although they were questioned by E. A. Fitch as late as 1882. The careful observations of early American writers, particularly Harris, Asa Fitch, Walsh, and Riley, had fixed the status of *Isosoma hordei* as a plant-feeder beyond all peradventure, but their conclusions were not accepted by certain English entomologists until Westwood had published his careful studies on *Isosoma orchidearum* and until Weyhenbergh had called attention to his earlier observations on a Dutch species. (See the writer's paper on the Biology of the Chalcididæ, Proc. U. S. Nat. Mus., vol. XIV, p. 585.) In addition to *I. hordei* Harris, the fact of phytophagy was established by Asa Fitch for his *I. secale*,[1] *tritici*, *hordei*, and *fulvipes*. The last of these, as we have shown by comparison of the type specimens, is synonymous with Harris's *I. hordei*, and the third, therefore, through preoccupation of the name, needs a new designation. Riley has also proved conclusively that his *I. tritici* (here treated as *I. grande*) is phytophagic. Of the other species which we treat below, the plant-feeding habit is perhaps not absolutely proven in each case, but the insects are structurally so closely related that, taken in connection with the proof at hand, this habit can not be doubted. The true European Isosomas have now practically all been accepted as plant-feeding species. Schlechtendal, in his "Die Gallbildungen der deutschen Gefässpflanzen" (Jahresbericht des Vereins für Naturkunde zu Zwickau, 1890), gives thirteen species of this genus as true gall makers in Europe.

Owing to the fact that an alternation of generations connected with a peculiar dimorphism has been established in the case of *I. tritici* Riley (= *I. grande*, form *minutum*) and *I. grande* Riley, it is quite likely that a similar phenomenon will be found to occur with more than one of the following species. In the majority of cases, however, the males have been associated with the females, and where species have been described from the females alone, these have been large and well-formed individuals, with no trace of degradational characters, such as the absence of wings, which would indicate that they are parthenogenetic forms. Moreover, *I. tritici* Riley has a somewhat different facies from the other members of the genus, consisting largely in its smooth aspect and one or two other minor points, which practically associate it with Haliday's genus *Philachyra*. While the writer is not inclined to give *Philachyra* generic importance, and considers that its species should be still associated with the true Isosomas, these feeble characters may still be associated with the phenomenon of dimorphism, and

[1] Walsh considered Fitch's species as synonymous with *hordei* since they were distinguished almost entirely by the coloration of the legs. Careful study, however, of Fitch's types, now in the possession of the United States Department of Agriculture, shows them to be distinct in other characters.

we may not find this characteristic present with more typical Isosomas. This supposition is to a certain extent supported by the fact that an examination of certain of Portschinsky's species of Russian Isosomas, sent us by Professor Portschinsky some years ago, shows that his *I. apterum* and *I. eremitum* belong to the smooth *Philachyra* group, and that the former, as the name shows, is wingless. It may further be considered suggestive that only females of *apterum* were received from the Russian writer, while both a male and a female of *eremitum* were received. Does this not immediately hint at a possible alternation of generations with these two so-called species? This coincidence further suggests that *Philachyra* may be a valid genus after all, even though we are able to separate it from *Isosoma* by no other morphological character than the smoothness of the integument.

ANALYSIS OF THE SPECIES OF ISOSOMA.

Females.

Mesonotum smooth, polished, shining.
- Winged ..... *grande*, form *grande*
- Wingless ..... *grande*, form *minutum*

Mesonotum coarsely, more or less umbilicately, punctured.
- Pronotal spot wanting ..... *bromi*
- Pronotal spot moderately large and rather distinct ..... *hageni*

Mesonotum rugulose, shagreened or coriaceous; not umbilicately punctured.
- Thorax nearly smooth, feebly shagreened or coriaceous and more or less shining.
  - Central furrow of metanotum incomplete ..... *websteri*
  - Central furrow of metanotum complete.
    - Metanotal furrow with a complete median longitudinal carina.
      - Cheeks very full and hairy ..... *hirtifrons*
      - Cheeks not especially full and hairy ..... *maculatum*
    - Metanotal furrow with no median carina.
      - Metanotal furrow shallow and transversely striate ..... *elymi*
      - Metanotal furrow strongly emarginate; not striate ..... *bromicola*
    - Metanotal furrow with an incomplete median longitudinal carina.. *fitchi*
- Thorax more coarsely shagreened or finely rugulose, opaque or subopaque.
  - Abdomen shorter than thorax.
    - Much shorter than thorax, subglobose ..... *agrostidis*
    - Nearly as long as thorax, oblong oval ..... *captivum*
  - Abdomen longer than thorax.
    - Pronotal spot minute ..... *hordei*
    - Pronotal spot large, distinct.
      - Second abdominal segment longer than fourth and fifth together *secale*
      - Second abdominal segment shorter than fourth and fifth together *tritici*

Isosoma (Philachyra) grande Riley (fig. 1).

Isosoma tritici Riley, American Naturalist, March, 1882, p. 247.
Isosoma grande Riley, Ann. Rep. U. S. Dept. Agric., 1884, p. 358.

This species differs at once from all the other American forms by its smooth, polished, and shining mesothorax. Next to *hordei* it is the best known and most important, economically speaking, of the North American species. It is the only species of *Isosoma* for which a true

alternation of generations has been established. The small wingless form, originally described by Riley as *tritici*, is the vernal generation, and consists of both sexes. The large winged form, described as *grande*, is the summer generation, and consists entirely of females. The species is widespread, occurring through the middle belt of country from the Atlantic to the Pacific, and has been reared only from wheat stalks.

The name *tritici* Riley falls on account of its pre[illegible] Dr. Riley was familiar with Fitch's name, but revi[illegible] species, thinking with Walsh that *tritici* Fitch was [illegible] Harris. Riley's name, however, even in that eve[illegible] rejected under the law of "once a synonym alway[illegible] dimorphism in this species is fortunate, since it enables us to retain

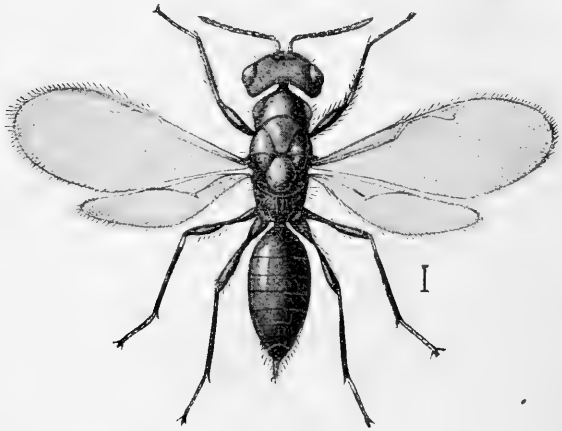

FIG. 1.—*Isosoma grande* Riley.

Riley's name for the summer form as the specific name. The species must, therefore, be known as follows:

Isosoma grande Riley.

Form *grande*=winged summer generation.

Form *minutum*[1] (proposed in place of *tritici*)=wingless spring and winter generation.

Isosoma californicum n. sp.

Female.—Length, 5 mm.; expanse, 8 mm. Head and thorax rather coarsely umbilicate-punctate; petiole distinct, but short and stout; abdominal segments 5 to 8 shorter than 4, 2 and 5 subequal, 3 and 4 subequal; mesoscutellum pointed at tip, axillæ nearly meeting; metanotum with a straight central longitudinal groove which is regularly concave from side to side and slightly emarginate at borders; each side of the groove the metanotum is coarsely umbilicate-punctate; hind coxæ plainly granulate above. Antennæ rather short and stout; joints

[1] For a good figure of form *minutum*, see Ann. Rept. Dept. Agric., 1881–82, plate xii, fig. 3

well separated, cup-shaped; funicle joint 1 about as long as pedicel, but longer and narrower than succeeding joint; joints 1–4 each slightly wider than preceding joint; club ovate, as long as two preceding funicle joints together. Abdomen longer than thorax, shining, with very faint sculpturing; penultimate and antepenultimate segments with abundant white pile, which also occurs on the pygidium as well as the head and thorax; spur of stigmal club given off just before tip and reaching farther toward apex of wing than does tip of club; pronotal spot lacking, pronotum uniform jet black, as is the rest of the body; the place ordinarily occupied by the yellowish pronotal spot somewhat sunken, has a finer sculpture, and is lacking in the white pile found elsewhere on the thorax. All legs uniform dark honey-yellow except coxæ, which are black; scape dark honey-yellow; wing veins light brownish-yellow.

Male.—Closely resembles female. Antennæ long and stout; scape slightly expanded below; pedicel small, globose; funicle joints strongly arched above, not constricted in middle, markedly pedicellate, and each with two half whorls of long hairs; funicle joint 1 nearly twice as long as 2; 2, 3, 4, and 5 subequal in length; club elongate, pointed, as long as two preceding funicle joints together. Punctation somewhat less distinct; legs black, except tarsi and tips of femora and tibiæ, which are yellow; petiole stout, as long as first abdominal joint.

Described from 5 females and 10 males captured April 20, 1891, by Albert Koebele, in the upper part of Shepherd's Canyon, Argus Mountains, California, upon *Eriocoma cuspidata.* The insects were collected in numbers at rest upon the upper part of the plant just before dusk. Upon examining the grass stalks Mr. Koebele found that they contained holes from which the Isosomas had apparently emerged.

Isosoma bromi n. sp.

Female.—Length, 3.4 mm.; expanse, 5.6 mm. Head and thorax densely umbilicate-punctate, punctations rather finer and closer than in preceding species; pronotal spot wanting; abdomen without a trace of sculpture, not longer than thorax, but more swollen than in preceding species; mesoscutellum and metanotum as with *californicum*, except that the metanotum each side of median groove is not so coarsely punctate; claw of stigmal club strongly curved; front coxæ honey-yellow, middle and hind coxæ black; front femora and tibiæ honey-yellow, middle femora honey-yellow, tibiæ darker, hind femora and tibiæ dark brown, yellowish at joints.

Male.—Length, 3 mm.; expanse, 5.4 mm. Antennæ as with *californicum*, except that joint 1 of funicle is less than twice as long as 2, and is regularly furnished with long hairs not arranged in whorls. Petiole slenderer than with preceding species, little longer than coxæ, and not as long as first segment of abdomen.

Described from 2 females and 1 male reared from *Bromus ciliatus*, in May and August, 1887, at Los Angeles, Cal., by Albert Koebele.

Isosoma hageni n. sp.

Female.—Length, 4 mm.; expanse, 7 mm.; head and thorax rather coarsely reticulate-punctate, the interspaces of the reticulations finely granulate. Metanotum with three faint subparallel longitudinal submedian carinæ. Pronotal spot moderately large and rather distinct. Abdomen a little shorter than the thorax, second segment occupying about one-third of its dorsum; segments 3, 4, [illegible] segment 5 a trifle longer. Petiole rugose, stout; [illegible] greened. Antennæ not in good condition for study in the [illegible] at hand—broken in one and with the pupal sheaths [illegible] Stigmal club, rounded; spur distinct, straight.

Color, black; apical third of front femora and tibia and tarsi of the same legs, honey-yellow; knees and tarsi of middle and hind legs also honey-yellow; pubescence of entire body short and sparse, light in color.

FIG. 2.—*Isosoma agrostidis* Howard.

Described from two female specimens from the collection of the Museum of Comparative Zoology, Cambridge, Mass., labeled in the handwriting of Dr. Hagen, "In quick grass, Boston, March, 1883, H. H."

Isosoma agrostidis n. sp. (fig. 2).

Female.—Length, 2.8 mm.; expanse, 5.2 mm. Head and mesothorax finely shagreened and also very sparsely and finely rugulose; metanotum somewhat coarsely rugulose and without a median furrow, but with a rather faint median longitudinal carina; mesoscutellum rather rounded at apex, not sharply pointed; axillar and parapsidal sutures nearly meeting; pronotal spot evident but small, scarcely seen from above; first funicle joint of antennæ not twice as long as second; remaining joints subequal, somewhat rounded; club joints very distinct, terminal one acuminate and styliferous. Abdomen short and stout, considerably shorter than thorax; subglobose in shape, its sec-

ond segment occupying nearly half of the whole surface; segments 3 to 7 short, subequal. Entire body very free from pilosity, except metanotal fimbria, which is pronounced and white, and except hind coxæ which have slight whitish pilosity on the outer side. Claw of stigmal club straight, issuing from tip of club and extending considerably beyond it, club itself abruptly truncate, triangular. Entire body, including legs, black, except pronotal spot, femoro-tibial knees and tarsi, which are dark honey-yellow.

Described from two female specimens reared by Albert Koebele, from small galls occurring rarely upon a grass of the genus Agrostis, collected at Summit, Placer County, Cal., in September, 1885. The galls were distinct elliptical swellings about 7 to 10 mm. long and from 2 to 3 mm. in greatest diameter, and occurred upon different parts of the stalk.

Isosoma captivum n. sp. (fig. 3).

Female.—Length, 3.4 mm.; expanse, 5.8 mm. Head and mesonotum uniformly, finely, and closely rugulose, not shagreened; metanotum

FIG. 3.—*Isosoma captivum* Howard.

more coarsely rugulose and with a narrow and shallow central longitudinal groove which widens slightly posteriorly; pronotal spot plain, moderately large; hind coxæ delicately punctate. Abdomen shiny, as long as thorax, oblong-ovoid; the second segment occupying nearly one-third the whole surface; segments 4 to 6 subequal, the third a little shorter; funicle joints 2 to 5 subequal; club nearly as long as three preceding joints; joint 1 one-half longer than 2; pile sparse and short, more marked at metanotal fimbria and terminal joints of abdomen than elsewhere. Color uniform black, except for pronotal spot, tarsi, middle and hind femoro-tibial knees, front tibiæ and apical third of front femora, which are light honey-yellow. Stigmal club about as in preceding species, except that its tip is more rounded instead of squarely truncate.

Male.—Length, 2.5 mm.; expanse, 5 mm. Punctation rather finer than with female; petiole as long as first abdominal joint, strongly

rugose; flagellum of antennæ long; pedicel not globose, slightly elongate; joint 1 of funicle longest, twice as long as pedicel; joints 2, 3, 4, and 5, each a little shorter than its preceding joint; not so strongly pedicellate as with *I. californicum* and *I. bromi*, moderately arched above with the hairs arranged in two indefinite whorls; club separated into two subequal pedicellate joints, giving funicle the appearance of being 6-jointed instead of 5-jointed, as with *bro*[illegible] scape short, about as long as pedicel and first [illegible] strongly expanded below tip. Coloration like th[illegible]

Described from 17 females and 12 males cap[illegible] by Prof. [illegible] Webster, in May, 1885–86, at Normal, Ill., and L[illegible] grass.

Isosoma elymi French (fig. 4).

Isosoma elymi French, Canadian Entomologist, vol. XIV, p. 9, 1882.

Female.—Length, 3.8 mm; expanse, 7 mm. Head and mesonotum delicately shagreened, not rugulose; metanotum with a central longitudi-

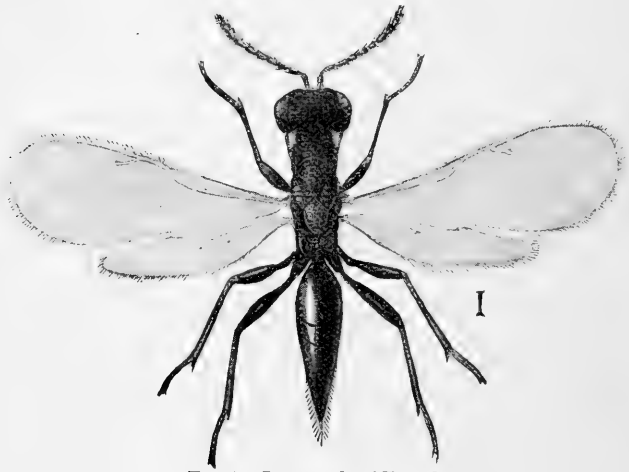

FIG. 4.—*Isosoma elymi* French.

nal furrow, rather broad and shallow and transversely striate; each side of the posterior two-thirds of the groove is a broad, flat space, closely and finely granulate; above this space is a coarsely rugulose area; pronotal spot very large and conspicuous, occupying one-half of the dorsal aspect of the anterior border of the pronotum. Entire body rather closely but finely pilose. Antennæ unusually hairy; joint 1 of funicle nearly twice as long as joint 2, which is about the same length as pedicel; joints 3, 4, and 5 about equal to 2; club as long as three preceding joints together. Abdomen as long as thorax; joint 2 as long as 3, 4, and 5 together; joints 4 and 5 subequal, 6 and 7 a little longer. Scape and legs black; apical one-third of anterior femora, front tibiæ, all tarsi, and knees of middle and hind legs, honey-yellow; the pronotal spot lighter yellow; claw of stigmal club given off just before the

tip and not extending farther than tip of club in the direction of apex of wing.

Redescribed from 1 female specimen reared from *Elymus americanus* at Carbondale, Ill., April, 1882, by Prof. G. H. French.

Isosoma maculatum n. sp.

Female.—Length, 3.8 mm.; expanse, 5.4 mm. Sculpturing of head [illegible] as with preceding species; metanotum with a very [illegible]y margined, central longitudinal furrow, including [illegible]rly its whole length a median longitudinal carina; the [illegible]rite irregularly and coarsely rugulose, the elevations mainly taking a longitudinal direction; hind coxæ faintly granulate above; pronotal spot very large, even more pronounced than with preceding species and covering two-thirds of dorsal aspect of fore border of pronotum; axillæ meeting at tip. Antennæ as with preceding species, except that club is decidedly flattened from sides. Abdomen smooth and shining, not quite as long as thorax; segments 3 to 5

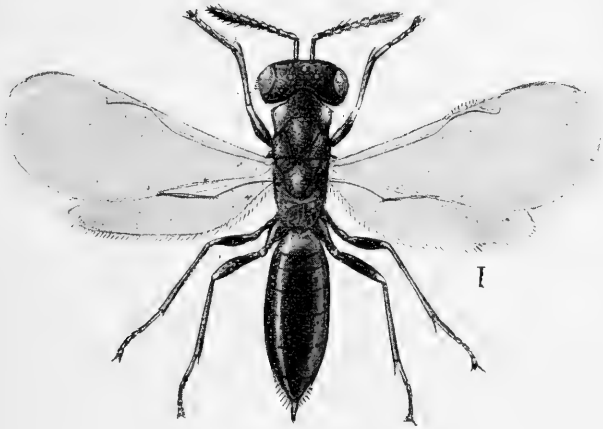

FIG. 5.—*Isosoma websteri* Howard.

slightly and gradually increasing in length; joint 6 a little shorter than 5; flagellum of antennæ rather shorter than preceding species; relative proportions of joints about the same. Body sparsely hairy; stigmal club as with preceding species. Coloration as with preceding species.

Described from two female specimens collected on blue grass May 19, 1886, and June 3, 1885, at Lafayette, Ind., by Prof. F. M. Webster.

Isosoma websteri n. sp. (fig. 5).

Female.—Length, 3.4 mm.; expanse, 6.3 mm. Head, pronotum, and mesonotum as with preceding species; metanotum with only the beginning of a central furrow, its lateral carinæ immediately curving around to the sides, each inclosing an oval, flattened, nearly smooth portion of the metascutellum; a median carina extending nearly to the tip of the

sclerite; pronotal spot moderately large and plainly seen from above, occupying a little more than one-third of the dorsal aspect of the pronotal foreborder. Abdomen much longer than thorax; segments 3 to 5 increasing in length; 6 and 7 as long as 5. Antennæ with joint 1 of funicle twice as long as 2; joints 3, 4, and 5 gradually decreasing in length, subequal in width; joint 5 more closely connected with club than with preceding joint. Color and wing venation as with preceding species.

Described from 7 female specimens collected on wheat at Normal, Ill., by Prof. F. M. Webster, in May, 1884.

Isosoma hirtifrons n. sp. (fig. 6).

Female.—Length, 3.7 mm.; expanse, 7 mm. Sculpturing of head, pronotum, and mesonotum as in preceding species, except that there are sparse, large, shallow punctures on mesoscutellum; cheeks much fuller than in other species; metanotum as with *I. maculatum*. Abdomen

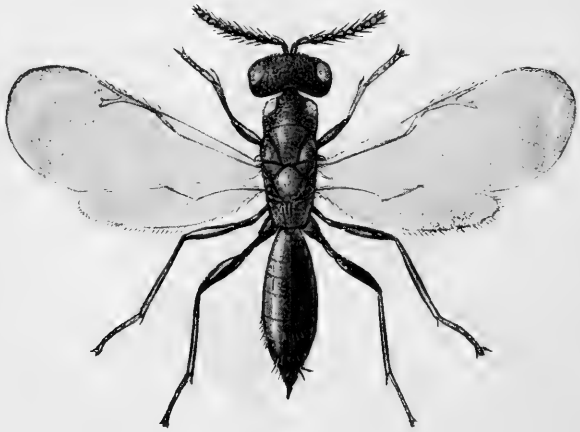

FIG. 6.—*Isosoma hirtifrons*, Howard.

about as long as thorax; segments 3 to 6, increasing in length. Antennæ stout, moderately long, very hairy; proportions about as in preceding species. Body not unusually pilose, except face, which is closely covered with short white pile; pronotal spots very plain, but not large, occupying about one-third of the dorsal aspect of the fore-border of the pronotum. Color black, except for all femero-tibial knees and pronotal spot. Claw of stigmal club given off some distance before tip, delicate and short.

Described from 4 female specimens reared by Mr. D. W. Coquillett March 13, 1886, from rye stalks which he collected in Mercer County, Cal., June 21, 1885.

Isosoma bromicola n. sp.

Female.—Length, 3.1 mm; expanse, 4.6 mm. Punctation of head, pronotum and mesonotum like that of *I. maculatum*, which it also resembles

in the large pronotal spots. Metanotum with a distinct, strongly emarginate central longitudinal groove, the space either side finely granulate, with occasional irregular carinæ. Abdomen longer than thorax; segment 2 as long as 3, 4, and 5 together; 5 and 6, subequal. Antennæ rather long and straight; pilose; joint 1 of funicle only slightly longer than joint 2; club not quite as long as three preceding joints together, strongly flattened from side. Face very slightly pilose; metanotal fimbria sparse. [illegible] whole insect is smaller, slenderer, and more deli- [illegible] appearance than any except *grande*, form *minutum*.

[illegible]—Length, 1.9 mm; expanse, 3.4 mm. Petiole short, not as long as first abdominal segment and scarcely as long as hind coxæ, scape of antennæ slightly widened; funicle joints very slightly rounded above and very slightly pedicellate; each more than twice as long as pedicel and each faintly constricted in middle; club divided into two pedicellate joints as with *I. captivum*. All legs black with light-yellow knees.

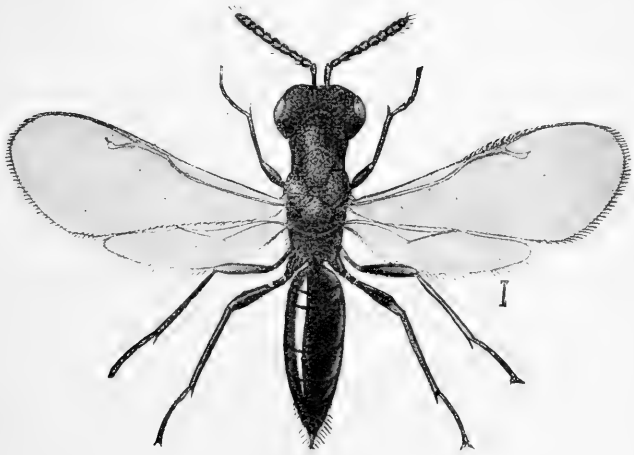

FIG. 7.—*Isosoma tritici* Fitch.

Described from 11 females and 7 males reared by Mr. Albert Koebele, at Los Angeles, Cal., from *Bromus ciliatus* collected at Millard's Canyon, Los Angeles County, Cal. The adults issued in March, 1887, from grass collected September, 1886.

Isosoma tritici Fitch (fig. 7).

Eurytoma tritici Fitch, Jour. N. Y. State Agricultural Society, 1859, vol. x, p. 115.
Isosoma hordei Walsh, Amer. Entomologist and Botanist, Oct., 1870, vol. II, p. 332.
Decatoma basilaris Provancher, Faun. Ent. Can., vol. II, p. 569.
Isosoma nigrum Cook, Rural New Yorker, June, 1885, p. 314.

Female.—Length, 4 mm.; expanse, 7.6 mm. Head, pronotum, and mesonotum strongly rugulose but not umbilicate-punctate except toward tip of scutellum, where an occasional umbilicate puncture occurs; metanotum also strongly rugulose with a faint trace anteriorly of a median longitudinal furrow; metanotal spiracles large and per-

fectly circular; pronotal spots moderately large and often faint, but plainly discernible from above, sometimes, however, quite bright and distinct. Abdomen longer than thorax, nearly as long as head and thorax together; abdominal segments 4 and 5 together longer than 2; 3 only about half as long as 4, and 5 as long as two preceding united; first funicle joint one-half longer than second; club longer than three preceding funicle joints together. Body slightly but plainly pilose except at sides of metanotum, where the fimbria is very obvious. Legs black except at joints, which with the tarsi are yellow. Claw of stigmal club given off before the tip.

Male.—Length, 2.9 mm.; expanse, 6 mm. Petiole shorter than hind coxæ, faintly punctate; flagellum of antennæ uniformly pilose, joints well rounded above, not strongly pedicellate; joint 1 three times as long as wide and nearly three times as long as pedicel; none of the funicle joints constricted in the middle; joints 2 and 3 each nearly as long as 1; joints 4 and 5 each a little shorter; club plainly divided by a distinct incision into two joints, but the terminal ovate joint is not pedicellate.

Redescribed from many male and female specimens reared in December and January, 1885, from wheat stalks collected in Louisa County, Va.; from other specimens received from A. J. Cook, Lansing, Mich.; from others reared by J. H. Comstock, at Ithaca, N. Y., from straw collected in the immediate vicinity; from other specimens received from J. A. Lintner, Albany, N. Y.; from specimens from the Asa Fitch collection, labeled "*Eurytoma tritici* Fitch, Maryland, E. L. Rogers;" from specimens collected on grass at Lafayette, Ind., by F. M. Webster; from specimens received from S. O. Diom, Grantsville, N. C.; from many specimens reared from *Elymus americanus* by Albert Koebele, in Los Angeles, Cal., and from many more specimens reared by the same gentleman from a grass which was supposed by Mr. Koebele to be either *Bromus ciliatus* or a species of *Agropyrum*, in the Santa Cruz Mountains, California.

Isosoma hordei Harris.

Ichneumon hordei Harris, New England Farmer, July 23, 1830, vol. IX, p. 2.
Eurytoma fulvipes Fitch, Seventh Rept. Ins. N. Y. (sep. ed.), 1862, p. 154.
Isosoma hordei (var.), Walsh, Amer. Entom., Oct., 1870, vol. II, p. 330.

The writer is able to positively assert that Harris's *I. hordei* is identical with Fitch's *I. fulvipes*. Fitch's types are in the possession of the United States National Museum, and through the kindness of Mr. Samuel Henshaw, of the Boston Society of Natural History, I have been able to critically examine Harris's types, consisting of 2 males and 2 females, fragmentary it is true, but perfectly recognizable. The specimens are labeled "281," and the record, as I am informed by Mr. Henshaw, reads "281 *Eurytoma hordei* H. N. E. Farmer, Insect (parasitic?) in Barley, June 15, 1830."

Female.—Length, 3.6 mm; expanse, 6 mm. Pronotum and mesonotum minutely but strongly rugulose, smoother than *I. tritici;* metanotum

more coarsely rugulose, the larger elevations taking a longitudinal direction, no central furrow or carina; pronotal spot very small, not visible from above. Abdomen as long as head and thorax together; joints 4, 6, and 7 subequal in length, the fifth a little longer; joint 3 a little longer than 4; 2 hardly longer than 3 and 4 united; funicle joints 2 to 5 submoniliform, but still a little longer than broad. All legs (except coxæ) and antennæ honey-yellow, flagellum and femora a little darker; claw of stigmal club straight, given off well before tip of club; pilosity sparse.

Male.—The only males which I have seen are the two from the Harris collection. These are both in very bad condition; neither has an abdomen and one has no antennæ. With the other but three funicle joints remain on the left antenna (the others being broken off) and four on the right, but the latter are still inclosed in the pupal sheath. The three funicle joints remaining on the left antenna are not pedicellate, very slightly arched above, and furnished with close, moderately short hair not arranged in whorls; joint 1 longest, 2 and 3 successively decreasing. Joint 4 is still shorter, judging from the sheathed right antenna.

Described from 14 female and 2 male specimens, two females from the Fitch collection, labeled in Fitch's handwriting "*Eurytoma fulvipes* Fh.," ten females reared in the Division of Entomology, January 23, 1883, from stems of barley received from W. Couper, "Canada West," and two females and two males from the Harris collection, reared from barley, June 15, 1830.

Isosoma secale Fitch.

Eurytoma secalis Fitch, Amer. Agric. Aug., 1861, vol. xx, p. 236.
Isosoma hordei (var.) Walsh, Amer. Entom., Oct., 1870, vol. II, p. 330.

Female.—Length, 3.6 mm.; expanse, 6.6 mm. Punctation as with preceding species; pronotal spot large, plainly seen from above. Abdomen as long as head and thorax; segments 4 and 5 subequal; 6 and 7 together shorter than 5; 2 much longer than 4 and 5 together. Color black; scape and legs black; front tibiæ, knees, and tips of middle and hind tibiæ and all tarsi honey-yellow; claw of stigmal club given off near tip of club, somewhat curved; antennæ as with preceding species.

Male.—Length, 3 mm.; expanse, 5 mm. Specimen in rather poor condition. Expansion of scape more abrupt from tip than with other males described; funicle joints well arched above, scarcely pedicellate, each with two indefinite whorls of hair and with no median constriction; each joint twice as long as wide; club plainly divided into two joints, but no trace of pedicel to terminal joint, resembling *hordei* in this respect; petiole a little shorter than hind coxæ and shorter than first abdominal segment.

Redescribed from one female and one male from Fitch's collection labeled *Eurytoma secale*.

Isosoma fitchi n. sp.

Eurytoma hordei Fitch (nec Harris) Seventh Rept. Ins. New York (author's edition), p. 154, 1862.

Female.—Length, 3 mm.; expanse, 5.8 mm. Head, pronotum, and mesonotum faintly shagreened, nearly smooth, shining; mesoscutellum with a few sparse punctures; metanotum with a complete median longitudinal furrow emarginate on the anterior half and with a central carina extending nearly to tip; very coarsely rugulo[illegible] furrow with a faint granulation between raised lines[illegible] large, plainly seen from above and two spots together [illegible] one-third of the dorsal aspect of the foreborder of [illegible] Antennæ with well separated joints; funicle joints 2, 3, 4, and 5 equal in length and width; joint 1 a little longer; joint 5 as well separated from club as from preceding joint; club a little longer than 4 and 5 together but of the same width. Abdomen as long as thorax; joint 4 shorter than 6; 5 longer than 6; 7 and 8 subequal. Color black, except for pronotal spot and knees, which are luteous; claw of stigmal club given off about at tip of club, straight.

Male.—Length, 2.2 mm.; expanse, 4.2 mm. Petiole about as long as hind coxæ and nearly equal in length to first abdominal segment. Antennæ with funicle joints very slightly arched above, each joint fully three times as long as wide and slightly constricted in middle; otherwise as with *I. hordei.*

Described from 2 females and 1 male in the Fitch collection, labeled in Fitch's handwriting "*Eurytoma hordei* Harris, Nos. 15223 and 15197."

Genus ISOSOMORPHA Ashmead.

Isosomorpha muhlenbergiæ n. sp.

Female.—Length, 2.2 mm.; expanse, 4.8 mm. Thorax with close faint umbilicate-punctate sculpturing; metanotum with a straight central complete groove and a central carina indicated anteriorly—groove, however, not emarginate; entire thorax with a close and very short white pile except in metanotal groove, which is naked. Abdomen shorter than thorax, flattened from sides; joint 4 very long, longer than all the rest together; joints 2 and 3 subequal; joints 5 and 6 very short; joints 2, 3, 4, and 5 of antennal funicle, equal in length and width, subquadrate; joint 1 longer, twice as long as pedicel; club long, ovate, a little longer than funicle joints 4 and 5 together. Color black; front coxæ dark brown, black at base; all legs honey-yellow; scape slightly yellowish at base; wings hyaline; stigmal club very small; claw feeble.

Described from one female specimen reared from a gall on *Muhlenbergia diffusa*, closely resembling deformation made by *Isosoma hordei*, and collected July 25, 1891, by J. G. Barlow, at Cadet, Mo.

Genus EURYTOMOCHARIS Ashmead.

Eurytomocharis eragrostidis n. sp. (fig. 8).

Female.—Length, 1.8 mm; expanse, 4 mm. Head and thorax very faintly shagreened, with minute umbilicate punctures on pronotum and larger ones on mesoscutellum; metanotum with central longitud- [illegible] but not emarginate. Abdomen shorter than tho- [illegible] as long as 2 and 3 together; 2 and 3 subequal; 5 and 6 [illegible] globose funicle joints; joint 1 of funicle a little [illegible] than pedicel, others subequal; club ovate, a little longer than funicle joints 4 and 5 together. All legs, including coxæ, dark yellow brown.

Male.—Length, 1.2 mm; expanse, 2.6 mm. Petiole faintly sculptured, as long as hind coxæ; antennæ with the 5 funicle joints strongly arched above and pedicellate; the body of each joint nearly as wide as

FIG. 8.—*Eurytomocharis eragrostidis* Howard.

long; scape broad, slightly widened below; pedicel globose; club as long as two preceding funicle joints together, not obviously divided.

Described from very many male and female specimens reared September, 1885, and March, 1886, from stems of *Eragrostis poæoides*, collected at Lafayette, Ind., by F. M. Webster. The infested grass stem is as a general thing not at all or very slightly swollen. The larva excavates it for a distance of an inch or more and issues from a round hole. The first or second joint below the head seems to be the portion of the grass most commonly attacked.

Eurytomocharis triodiæ n. sp.

Female.—Length, 3.2 mm.; expanse, 5 mm. Resembles closely the foregoing species, except that it is considerably larger. Head, pronotum, and mesonotum coarsely umbilicate-punctate; metanotum with very shallow emarginate central furrow with transverse rugosities

throughout its full extent; the narrow expanse either side of furrow granulate; remainder of metanotum coarsely rugose. Abdomen as long as head and thorax together; fourth segment longer than second and third together; third twice as long as second; fifth equal in length to second. Entire thorax with close white pile. Antennæ about as with preceding species, except that joint 1 of funicle is longer than 2 and nearly twice as long as pedicel; club of stigmal vein triangular; claw not distinctly differentiated. Color, black; scape, honey-yellow; all legs brown, lighter at joints; femora and tibiæ, dark in the middle. All coxæ shagreened.

Male.—Length, 2.1 mm.; expanse, 3.2 mm. Petiole slightly rugose; distinctly longer than hind coxæ; antennæ as with preceding species, except that joint 1 of the funicle is longer than 2, and 2 is longer than 3, while club is not so long as two preceding joints together.

Described from 8 females and 1 male reared April 27 and May 17, 1888, from the dry stems of *Triodia cuprea* collected on the Virginia side of the Potomac River, near Washington, D. C., by Theodore Pergande.

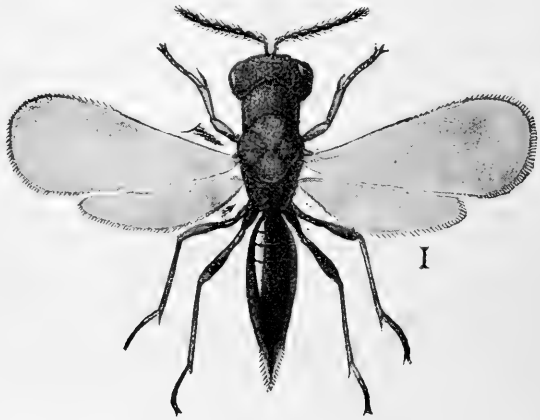

FIG. 9.—*Evoxysoma vitis*, (Saunders).

Genus EVOXYSOMA Ashmead.

Evoxysoma vitis (Saunders) (fig. 9).

Isosoma vitis, Saunders, Can. Entom. 1870, vol. II, p. 26.

Female.—Length, 3 mm.; expanse, 5.6 mm. Head, pronotum, and mesonotum closely and rather faintly umbilicate-punctate; metanotum with a broad central longitudinal depression with convex sides, delicately shagreened in center; mesopleura below tegulæ delicately shagreened; all coxæ also shagreened. Abdomen as long as head and thorax together; joint 4 as long as 2, 3, and 5 together; 2, 3, 5, and 6 subequal. Antennæ submoniliform; funicle joints 1 and 2 nearly equal in length, 1 slightly longer; remaining joints decreasing in length very slightly; club nearly equal to three preceding joints together; head and

thorax with close, fine, white pile, which is also present on terminal joints of abdomen. Color black, antennal scape yellowish; all coxæ black, the front pair somewhat yellowish at tip; front and middle legs except coxæ honey-yellow; hind femora brown in middle, honey-yellow at either end; hind tibiæ honey-yellow, slightly brownish in middle; base of abdomen below brownish; stigmal club well rounded, claw straight and short.

Male.—Petiole thick, shagreened, longer than hind coxæ, as long as first abdominal joint; antennæ as with male of *Eurytomocharis triodiæ*, except that the funicle joints are somewhat more strongly pedicellate. All legs, excepting middle and hind coxæ, honey-yellow.

Described from six females and four males apparently reared from grape seeds by C. V. Riley. The specimens are all in the old Riley collection, together with five shriveled grapes from which they have emerged. The series is probably the one referred to in the Second

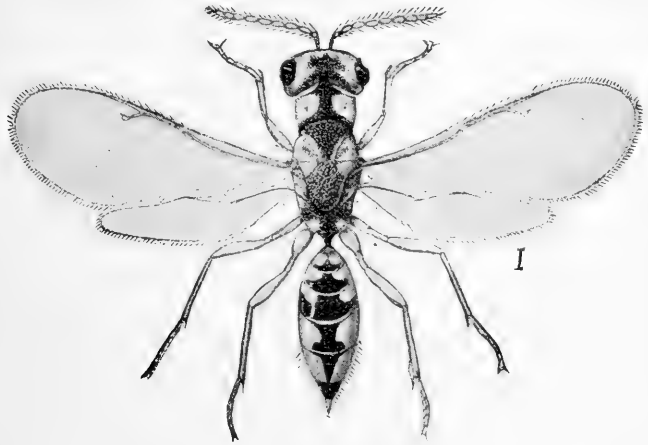

FIG. 10.—*Decatomidea cooki* Howard.

Report on the Insects of Missouri (p. 92), where it is stated that they were reared from infested grapes received in August, 1869, from A. S. Fuller, of New Jersey, and obtained by him from Canada. The evidence in favor of the phytophagic habit of the species, as given by Saunders in the Canadian Entomologist, is apparently conclusive, but there is still a chance that this species and the next one are parasitic or inquilinous. They hardly belong structurally to the phytophagic group of the Eurytominæ.

Genus **DECATOMIDEA** Ashmead.

Decatomidea cooki n. sp. (fig. 10).

Female.—Length, 3.6 mm; expanse, 5.8 mm. Head, pronotum, and mesonotum densely and rather coarsely and regularly umbilicate punctate; metanotum with a very broad central, slightly emarginate, and

very shallow shagreened furrow. Antennæ rather long, moniliform; funicle joint 1 more than three times as long as pedicel and nearly three times as long as thick; joint 2 shorter than 1, twice as long as thick; joint 3 a little longer than 2; 4 and 5 each as long as 2; club as long as 4 and 5 together. Body nearly naked; pile sparse. Color black; antennæ yellowish; all legs yellowish except hind coxæ, which are blackish above and below; underside of thorax all of [illegible] including margin behind the eyes, and underside [illegible] yellow of the abdomen extending dorsally [illegible] and sixth segments; fourth segment as long as second and third together; fifth longer than third, but shorter [illegible] sixth equal.

Described from one female specimen reared March 12, 1884, from grape seeds received January 28, 1884, from A. J. Cook, at Lansing, Mich. There are four specimens in the national collection received by Professor Riley in the fall of 1886 from Dr. Franz Loew, of Vienna. The females differ from the single female reared from the seed sent by Professor Cook only colorationally; the yellow is much more prevalent and the black is reduced to a series of dorsal markings. Of the four specimens received from Dr. Lowe, two are males and two females. The accompanying figure was drawn from one of the Loew females. With the males the antennæ are elongate, the dorsal whorls of hair on the funicle joints being very long, two distinct whorls to each joint, and the segment somewhat constricted between the whorls; not strongly pedicellate; joints 4 and 5 shorter than 2 and 3; club not longer than funicle joint 5. Each funicle joint is at least four times as long as broad, and the dorsal elevation is not strongly marked. In coloration the males are darker than the females. The longitudinal dorsal thoracic black band is broader behind although narrower on the pronotum, where it is supported on either side by a black dot. The dorsum of the abdomen is entirely black.

Dr. Loew wrote that the specimens were reared from seeds of *Vitis californica*. The seeds were imported from California to Vienna in the month of January. The imagos emerged from the seeds at some time between April 12 and June 15. A very great number of seeds were infested and the larvæ consumed the entire seed contents.

EXPLANATORY TO THE TECHNICAL SERIES.

While the work of the Division of Entomology is entirely carried on with the practical end in view, a certain amount of work of a technical character is constantly being done by different members of the force. The condition of our knowledge of North American insects at the present time is such that many forms which from time to time spring into prominence as destructive species, or as connected with destructive species, either as parasites or predatory enemies, are found to be new to science. They must be classified, described, and given names before they can be intelligently considered in economic publications. The practice which has prevailed to a limited extent of naming and describing new species in practical bulletins and reports is one which has met with much disfavor among systematic workers. Isolated descriptions of new species are in themselves sources of great annoyance to all workers, and when these isolated descriptions are published elsewhere than in scientific journals or the proceedings of scientific societies, the annoyance becomes intensified. The force of the Division of Entomology comprises several specialists who are doing descriptive work, and largely upon material accumulated in the course of the regular divisional work. They are doing this work as a necessary supplement to the purely economic output of the division, and to facilitate the investigations of the entomologists of the State Agricultural Experiment Stations. It becomes important that the results of their labors should be published promptly, and as all available sources of publication in this country, such as the Proceedings of the United States National Museum and the Transactions of the American Entomological Society, are chronically overcrowded with manuscripts, and are not published with any degree of promptitude, it is necessary that they should be issued by this Department.

L. O. H.

REVISION

OF THE

NEMATINÆ OF NORTH AMERICA,

A SUBFAMILY OF LEAF-FEEDING HYMENOPTERA OF THE FAMILY TENTHREDINIDÆ.

BY

C. L. MARLATT,
FIRST ASSISTANT ENTOMOLOGIST.

U. S. DEPT. OF AGRICULTURE
DIVISION OF ENTOMOLOGY
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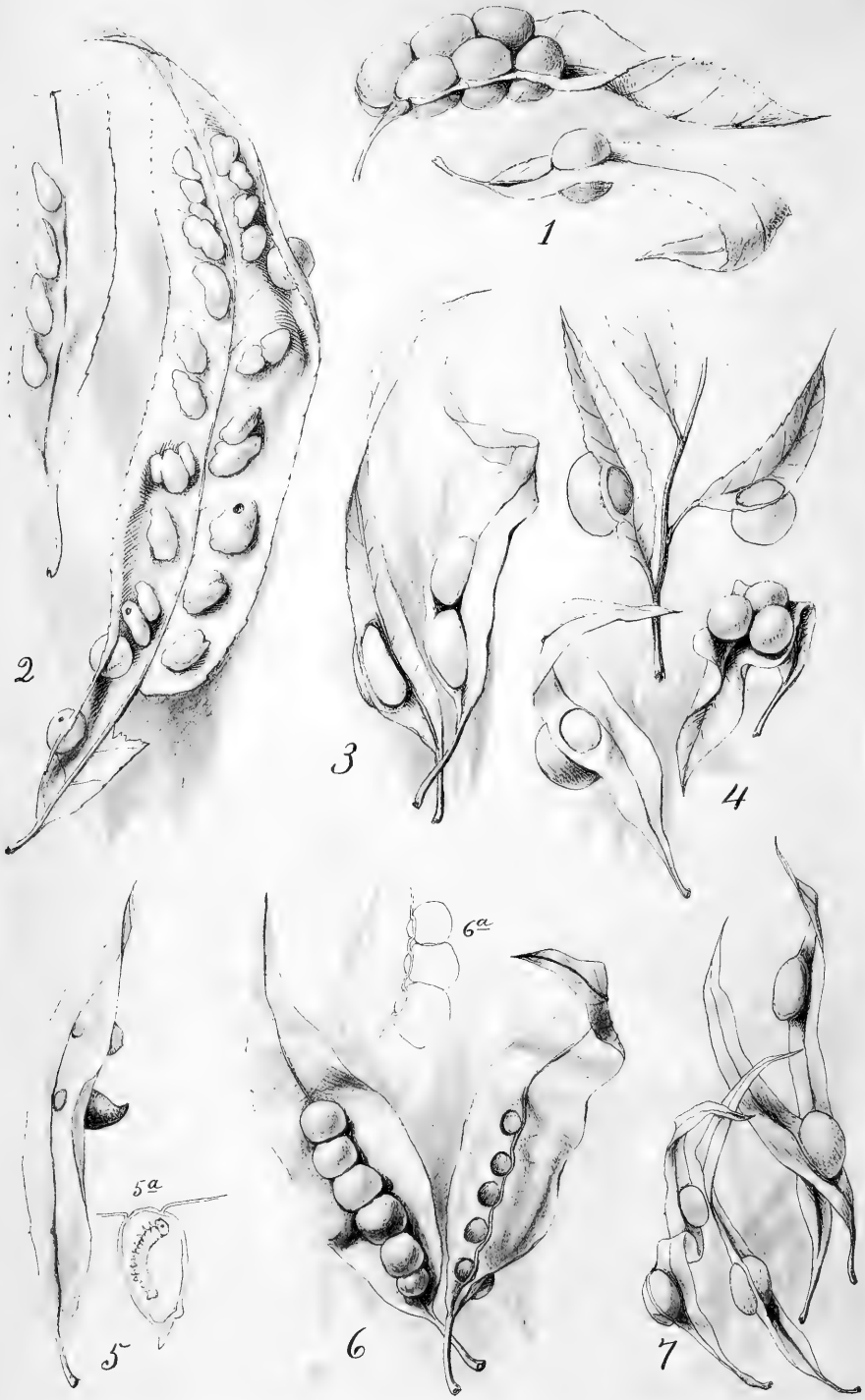

LEAF GALLS OF PONTANIA.

1. *Pontania resinicola* n. sp.
2. *P. hyalina* Norton.
3. *P. desmodioides* Walsh.
4. *P. pomum* Walsh.
5. *P. pyriformis* n. sp.
6. *P. monile* n. sp.
7. *P. bruneri* n. sp.

TECHNICAL SERIES NO. 3.

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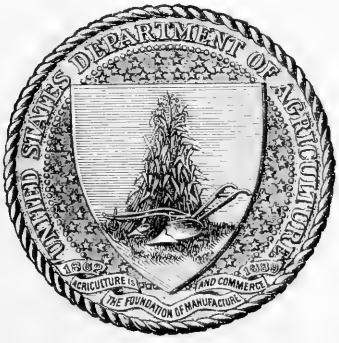

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1896.

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., February 25, 1896.

SIR: I have the honor to submit for publication the third number of the technical series of bulletins of this Division. It has been prepared by my first assistant, Mr. C. L. Marlatt, and consists of a monographic revision of the Nematinæ, an important subfamily of leaf-feeding hymenopterous insects of the family Tenthredinidæ. The larvæ of these insects are all plant-feeders and include among their number some very important enemies of cultivated plants. They represent, economically, the most important group of the family to which they belong.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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THE NEMATINÆ OF NORTH AMERICA.

INTRODUCTION.

The subfamily *Nematinæ* of Thompson or *Nematina* of Cameron (Konow's subtribe *Nematides*) comprises a very large group of closely allied species, distributed in the classification adopted by the author among nearly a score of genera. They range from very small insects to medium sized, but include no very large species, or in length from 2 to 12 mm. They are for the most part smooth, shining, and rather soft bodied, and are variously colored, but yet presenting frequently a confusing similarity in general form, and particularly in coloration, rendering their generic and specific references in some cases difficult. In point of number of species and abundance of individuals this subfamily far exceeds any other of the corresponding groups in the family Tenthredinidæ, and in variation and peculiarities in larval habits and in economic importance many of the species belonging to it have a very great interest.

Geographical distribution.—The Nematinæ are distinctly northern in their range, reaching their greatest development in abundance of species and specimens in the transition and boreal zones, and extend northward into circumpolar regions—species occurring abundantly in Greenland, Iceland, and Spitzbergen. Southward they become less and less numerous, and are practically wanting in tropical countries. This is illustrated very forcibly in Europe by the occurrence of over 70 species of the old genus *Nematus* in Scotland (Cameron) and 95 in Sweden (Thompson), as against 12 about Naples, Italy (Costa); and the same discrepancy exists between the temperate and subarctic region of America and the Southern States and Mexico.

Food-plants—Their food-plants cover a wide range, some species affecting grasses, one or two very destructive ones the grains, others various deciduous trees and shrubs, and still others conifers. The majority of the species occur, however, on plants of the families Salicaceæ, Betulaceæ, Rosaceæ, and Coniferæ, in the order given.

Life history and habits.—The Nematines are among the first sawflies to appear in spring, occurring abundantly on trees at the first appearance of the leaves. They do not often frequent flowers, except, at least, those of the plants upon which their larvæ feed. Many willow species, for example, occur abundantly on the earliest spring bloom of the willow.

In common with other sawflies, however, they rarely leave their larval food-plants, and to be collected successfully a knowledge of their habits in this respect is very desirable.

In number of broods great diversity is found, and the normal rule of most Tenthredinidæ, of a single yearly brood, is frequently deviated from. Some species are known to be limited in number of broods only by the length of the season, as, for example, *Pteronus ventralis* Say, the common willow species. Two annual generations are common, but many species are single brooded, the larvæ entering the soil or other material or remaining in their galls at the completion of growth and continuing in dormant condition until the following spring, when shortly before they emerge as perfect insects the change to the pupal condition takes place. The males normally appear a few days before the females, and the duration of the life of the adults of both sexes is short, not often exceeding a week or ten days. Of a large percentage of the species no males are known, and in the case of many species careful and repeated breeding records indicate that males are very rarely produced.

In some species parthenogenesis is complete; that is, the eggs from unimpregnated females produce other females. In other instances of parthenogenesis, however, either males only are developed from unfertilized ova or females very rarely.

The union of the sexes takes place very shortly after the appearance of the females and egg deposition closely follows. The eggs are inserted either singly or a number together in the young twigs, larger veins, petioles, in the surface parenchyma, or in the edges of the leaves, the single exception being the case of the gooseberry sawfly (*Pteronus ribesii*), which merely glues its eggs to the leaf without making any incision whatever.

Most of the species are external feeders on the foliage of plants, but the species of two genera, *Euura* and *Pontania*, so far as their habits have been studied, are gall makers, and pass their early life in the interior of the plants, either in the stems without causing abnormal growths or in the excrescences or galls on the stems and leaves. At least one American species develops in the rolled or folded edge of the leaf. The larvæ are 20-footed, some solitary, others gregarious—the latter usually more brightly colored and possessing means of protection in glands secreting a noxious fluid. Most of the solitary ones are green and not readily observed. They usually feed from the underside of the leaves, eating from the edge or cutting circular holes in the general surface, and in some cases taking everything but the stronger veins. Many species rest quietly during the day, feeding only at night. Some have the habit of throwing the posterior segments violently upward to frighten away parasites or enemies; others adhere to the leaves or twigs by the thoracic feet only, coiling the posterior segments under the middle ones.

The nematine larva, after its final molt,[1] generally enters the ground to pupate, spinning a double or single silken cocoon more or less incorporated with particles of earth exteriorly. In the case of the species having several broods annually, the cocoons, at least of the summer generation, are frequently constructed above ground, either among the dry leaves and rubbish at the base of the host plant, or on the twigs, or in crevices of the bark of the latter. Some of the gall species pupate in their galls, but many of them abandon their galls to undergo their transformations in rotten wood, in the pith of plants, in deserted galls, or in the earth.

Species living exposed on the leaves will also sometimes enter deserted galls, either to transform or to hibernate.[2]

Range of species and economic importance.—Some few species are known to be widely distributed, and this is particularly true of the larch sawfly, which occurs throughout Canada and the Northern States, and also in Europe. Whether this species (*Lygæonematus erichsonii* Hartig) can be called an introduced species or not is a question. Its wide distribution throughout the Northern States would seem to indicate that it has, perhaps for many centuries, occurred on both continents. The gooseberry and currant sawflies, however (*Pteronus ribesii* Scop. and *Pristiphora appendiculata* Hartig), are undoubted cases of importation. The economic importance of the group is well illustrated by the species just mentioned, the last two being among the most serious enemies of several small fruits, and the first threatening the almost total destruction of the larch forests in many districts. Other examples of very destructive species are the willow sawfly (*Pteornus ventralis* Say), the wheat sawfly (*Pachynematus extensicornis* Nort.), the Western pear sawfly (*Gymnonychus californicus* n. sp.), and the cranberry sawfly (*Pristiphora idiota* Nort.).

Difficulties arising from confusion of species and loss of types.—The classification of this natural and distinctly differentiated subfamily has been, until quite recently, in a very experimental and unsatisfactory condition, and this is particularly the case with the genus *Nematus*, which, cumbersome from the number of species referred to it, has been invariably a stumbling block to every student of the Tenthredinidæ. Following the lead of the earlier European writers on the group, American describers of species in the old genus *Nematus* have based their characterizations almost solely on mere differences in coloration, with such references to structural features as are of little value or of generic rather than specific importance. The failure to note the variations in the structure of different parts of the insect has led to the most

[1] See "The Final Molting of Tenthredinid Larvæ," Proc. Ent. Soc. Wash., vol. II, p. 115.

[2] See "Hibernation of Nematids and its bearing on Inquilinous Species," Proc. Ent. Soc. Wash., vol. III, p. 263.

confusing assemblage of different species under the same name, and, worse than this, the bringing together of representatives of different genera under a single species. This is well illustrated in the species *corniger* and *subalbatus*, under which names specimens were found grouped in the collections of the American Entomological Society which belong to at least four distinct genera. In cases like this it is sometimes difficult, particularly where the type specimens are lost, to decide to which genus the species bearing the original name should be assigned. The difficulties of the case have been greatly enhanced by the fact that Norton, who has described most of our species, allowed many of his types to be destroyed through his indifference in later life, after he had ceased studying the group, thus vitiating much of the excellent work of his earlier years. A box of his type specimens examined by me, which had recently been returned to the Entomological Society of Philadelphia, was so thoroughly disintegrated by vermin that scarcely a recognizable fragment remained.

The very careful work done in the last few years by Fr. W. Konow, of Fuerstenberg, Germany, particularly in separating the old bulky genus *Nematus* into some nine genera, has made it possible to take up this group much more satisfactorily than heretofore, and in the preparation of this paper Konow's system has been the basis of the classification adopted.

Sources of material.—The proper placing in the new genera of the species formerly included in *Nematus*, which in scarcely an instance can be gathered from the original descriptions, has necessitated the examination of all the old types of Norton, Cresson, and others, and these have been redescribed, whenever obtainable. The material in the genus *Nematus* in the collection of the American Entomological Society, which includes all of Cresson's and Norton's types, so far as they have been preserved, has been very kindly placed at my disposal. I have also had the National collection at hand, and material from a number of private collections, the most important of which are the Nematines from Cornell University, kindly loaned by Professor Comstock, and the types of Messrs. Harrington, Dyar, Forbes, Ashmead, and McGillivray. The types of Provancher's two species were also very kindly obtained for me by Abbé Huard. The types of Kirby's species and of a few others described abroad I have been unable to examine and refer generically, and the original descriptions of these, together with the descriptions of the lost types of Norton, are included in an appendix.

Structure and terminology.—In recharacterizing the old species and working up the large amount of new material which has accumulated, parts hitherto rarely used have been referred to and terms repeatedly employed throughout the descriptions which would be unfamiliar to most students. The following description of the salient characters used in the descriptions and the terminology will therefore be valuable.

The head is convex in front and more or less concave posteriorly. It presents in the characters of the clypeus and of the occipital and frontal ridges, together with the antennæ, very valuable characters for the separation of genera and species. The difficulty of examining the mandibles in dried specimens renders the use of these parts in descriptions inadvisable, and this holds true also of the maxillæ and labium. There is also usually a notable variation in structure between the right and left mandible. (See fig. 2.) The palpi of the maxillæ and labium, the former 6-jointed and the latter 4-jointed, are usually soft and lose shape more or less in drying, and are difficult to make out without softening and dissection. The clypeus, if emarginate at the apex, will present good differences in the nature of the emargination, whether

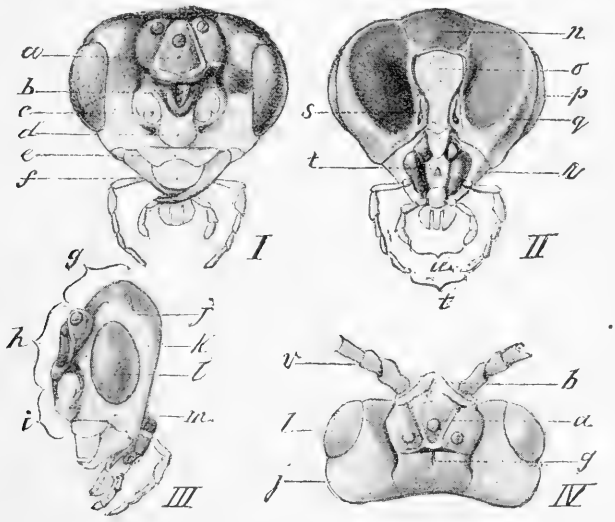

FIG. 1.—Head of *Pteronus:* I, front; II, rear; III, lateral; and IV, dorsal view: *a*, ocellar basin; *b*, antennal fovea; *c*, socket of antenna; *d*, hypoclypeal plate; *e*, clypeus; *f*, labrum; *g*, vertex; *h*, front; *i*, face; *j*, upper orbit or temple; *k*, posterior orbit; *l*, eye; *m*, lower orbit or cheek; *n*, occiput; *o*, occipital foramen; *p*, eye; *q*, cheek; *r*, mandible; *s*, occipital fossa; *t*, maxilla; *u*, labium; *v*, antenna (original).

broadly or narrowly, deeply or shallowly, and also in the character of the lobes produced by this emargination, whether they are rounded or triangular, and their width relative to the width of the clypeus. The vertex frequently presents very prominent grooves and ridges, and these, particularly the ridges surrounding the anterior ocellus and inclosing quite a large basin in front of it, are very important. The sides of this basin are either strongly and sharply or broadly and roundly elevated, or in some genera they are subobsolete or wanting, as in *Pristiphora.* The anterior wall of this basin is usually much more strongly raised and wider than the lateral walls, and frequently extends beyond the basin nearly to the compound eyes on either side. This I have termed in the descriptions the frontal crest. Between the bases

of the antennæ and immediately in front of this crest is a distinct depression or fovea—the antennal fovea—which varies remarkably in different species, but is quite uniform within species limits. In some cases this fovea breaks through the frontal crest, uniting more or less completely with the ocellar basin, in which case the crest is said to be broken. The apex of the more or less prominent ridge between the bases of the antennæ, in which this fovea is situated, is known as the antennal tubercle.

The antennæ are always 9-jointed, the two short basal joints constituting the scape and the others the flagellum. The antennæ are of great value in generic and specific characterizations, both in the matter of length relative to the body and in general shape and length of joints. They are usually simple and tapering, in some genera filiform, longer in the male than in the female, and frequently in the males with the basal joints of the flagellum more or less flattened or compressed. In some instances the basal joints, particularly in the males, are toothed or branched.

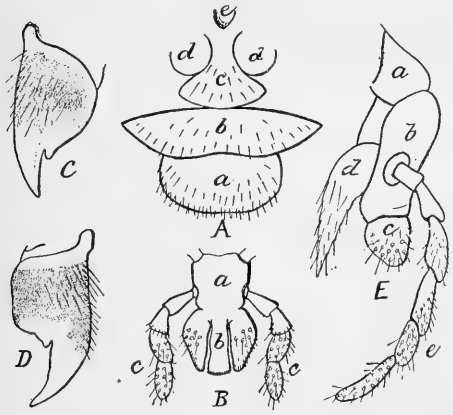

FIG. 2.—Mouth-parts of *Pachynematus erichsonii:* (A) *a*, labrum; *b*, clypeus; *c*, hypoclypeal plate; *d*, *d*, antennal sockets; *e*, antennal fovea. (B) Labium: *a*, mentum; *b*, ligula; *c*, *c*, palpi. (C) Right mandible. (D) Left mandible. (E) Maxilla: *a*, cardo; *b*, stipes; *c*, galea; *d*, lacinia; *e*, palpus (original).

The thorax, except in punctuation and hairy vestiture, presents few structural characters of value in specific description. It is important, however, to understand the terminology of the parts to properly appreciate the color descriptions. It presents a large number of sclerites—often small and somewhat obscure—which seem never to have been very carefully described, and some of the more important divisions have been very commonly misapprehended. The accompanying illustration (fig. 3) shows more fully than will be undertaken in the text the superficial anatomical structure of this division of the body. When softened and subjected to dissection, the thorax readily separates into three parts—not, however, on the lines commonly supposed to represent the divisions between pro-, meso- and metathorax. The pronotum attaches to the mesothorax and the so-called episternum of the metathorax is seen to be mesothoracic.

To the dorsal region of the prothorax the pronotum, or first division of the thorax, is generally assigned. This sclerite, as just indicated, is most intimately and inseparably fused with the mesothorax and is scarcely at all attached to the lateral and ventral sclerites of the prothorax, which support the head and to which the anterior legs are joined. On this ground, Kirby refused to consider this sclerite protho-

racic, but Burmeister and later authors have given good reasons for considering it to represent the dorsal arc of the prothorax or the pronotum, and it is so designated in this paper.

Belonging to the mesothorax are the tegulæ, anterior and lateral lobes of the mesoscutum, mesoscutellum, and mesopostscutellum (for brevity the second and third divisions are referred to as the anterior and lateral lobes and the scutellum). The mesopostscutellum is found to enter very deeply into the interior of the thorax, doubtless to furnish attachments for the powerful wing muscles (fig. 3, *i*), and forms an invagination which nearly cuts the body in half at this point. The division of the body at this point is analogous to the separation in

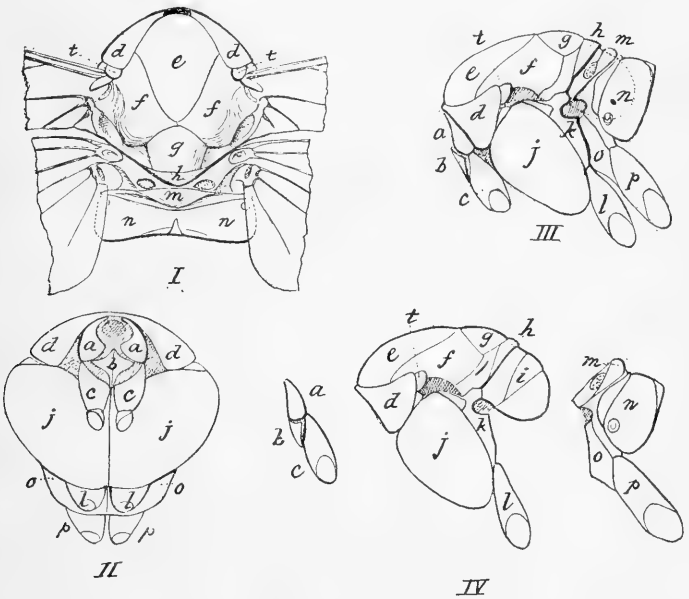

FIG. 3.—Thorax of *Pachynematus erichsonii:* I, dorsal view; II, ventral; III, lateral; and IV, lateral with segments separated. *Prothorax: a*, episternum; *b*, sternum; *c*, coxa; *d*, pronotum. *Mesothorax: e*, anterior, and *f*, lateral lobes of scutum; *g*, scutellum; *h*, postscutellum; *i*, mesophragma; *j*, epimeron; *k*, posterior plate of epimeron (?); *l*, coxa. *Metathorax: m*, scutum; *n*, scutellum; *o*, epimeron; *p*, coxa; *t*, tegula (original).

Coleoptera between the prothorax and mesothorax, the last thoracic division in sawflies being intimately joined with the abdomen, as are the last two divisions in beetles. Belonging to the metathorax are the metascutum and metascutellum.

This last sclerite—the metascutellum—is commonly designated in descriptions as the "basal plates," and these have always been matters for dispute among entomologists. Of the European writers, André, following Latreille and Audouin, considers them as constituting the dorsal arc of the first abdominal segment; Cameron, as representing a fourth thoracic segment (an impossibility from our accepted standard of the structure of insects), and Westwood, on grounds which seem

entirely valid, shows that they really represent the terminal sclerite of the metathorax, namely, the metascutellum. This is plainly apparent from an examination of the genus *Cephus*, where the parts are very plainly differentiated and their relationship easily deciphered. There is a suture or fold separating the narrow anterior margin of this sclerite, but the portion so separated is intimately joined to the posterior portion and need not be separately designated. This sclerite is strongly incised at the apex centrally and this incision is covered with a white membrane, which, in descriptions, is commonly referred to as the white blotch of the so-called basal abdominal segment. The universal occurrence of this white blotch and its slight variation, except in the case of the larger groups of genera, make it ordinarily of little value in descriptions of species. In the comparisons of older descriptions the white spot on the basal segment will be understood to mean this blotch, and in harmonizing these with the characterizations of species in the following pages it must also be remembered, in referring by number to the segments of the abdomen, that the so-called first segment belongs to the thorax.

The pair of white spots occurring on the upper edge of the metascutum, termed *cenchri*, also occur uniformly in all Tenthredinidæ and present no important variation in genera, and although they have been referred to in most of the older descriptions, it has not been deemed necessary to mention them in the characterizations of the following pages. These spots, uniformly oval and whitish in color and bearing a hexagonal surface sculpturing, have not been understood so far as their function is concerned. I am inclined to believe them to be sound organs, and that by the rubbing of the base of the subcostal veins of the hind wings over them a vibration of the cenchral plate or of the plate and vein results, which produces sounds audible to the insect ear. The structure of the cenchri has been hitherto erroneously given; they consist uniformly of projecting plates attached basally, which protect or cover openings into the thorax. In the case of the Lydinæ, the plate projects or is distinctly raised above the general surface, so that the free edge is plainly noticeable. The idea has therefore been that in the Lydinæ the true cenchri are covered by an overhanging plate. In this subfamily, however, these plates are the cenchri, there being no membrane or structure beneath them; and in other subfamilies the posterior free edge fits down more closely into the opening of the cavity, so that the fact that it has a free posterior and lateral margin may only be discovered by dissection.

The lateral and ventral aspect of the thorax includes, for the prothorax, an episternum and a central sternal plate; for the mesothorax, an epimeron and an episternum, and other sclerites which are rudimentary or unimportant. The meso-epimeron is very large and represents the bulk of the side and venter of the thorax. The divided sclerite immediately back of it, which supports on its upper extremity

the anterior wings, has by some authors been considered to represent the episternum of the metathorax. As already indicated, it is intimately fused with the mesothorax, and its place here is still further shown by its relation to the anterior wings. The epimeron of the metathorax is comparatively small, and the episternum is apparently wanting, unless the sclerite just above the metepimeron may be so considered.

The leg includes a large coxal joint, 2-jointed trochanter, and the femur, tibia, and tarsus occurring in the order named. In two genera the legs are characteristically shaped—*Crasus* having the apex of the hind tibiæ and the metatarsus broad and flattened, resembling the condition obtaining in social bees, and *Holcocneme* having these parts somewhat enlarged and the posterior tibiæ distinctly grooved exteriorly. This last character is, however, present in other genera, though less distinctly. The tibial spurs, of which there are two at the apex of each tibia, do not vary sufficiently to be of much value in generic or specific descriptions. The forward one of the anterior pair of legs is much stronger than the others, and doubtless serves the rôle of an antennal scraper, as does the corresponding spur in other Hymenoptera.

The claws, while affording primarily generic characters, are of some value in the characterization of species. Three distinct types of claws are noted, viz, the first, in which the claw is more distinctly cleft, the two teeth, which have been termed rays throughout the descriptions, extending in a direction nearly parallel, the inner ray being commonly not much shorter than the outer (fig. 4, *d*, *e*, *f*); the second form of claw consists in the projection of a minute tooth well within the apex of the claw and extending nearly at right angles to the claw (fig. 4, *b*, *c*); and the third, a simple claw, without branch or tooth (fig. 4, *a*).

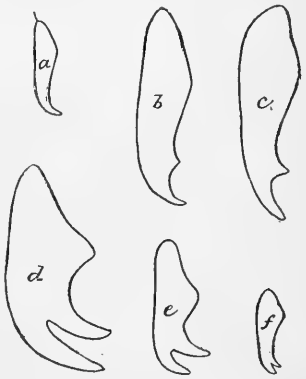

FIG. 4.—Types of claws: *a*, *Gymnonychus californicus*; *b*, *Pachynematus extensicornis*; *c*, *Lygæonematus erichsonii*; *d*, *Amauronematus luteotergum*; *e*, *Pteronus cornelli*; *f*, *Pontania agilis* (original).

The abdomen is ovate or elliptical, less commonly elongate, as in *Euura*, and usually more or less depressed. It presents in the female nine dorsal arcs, if the small terminal sclerite attached to the large overlapping eighth arc is considered to be distinct. This last sclerite, the ninth, bears laterally within the margin at its base the two unjointed appendages known as cerci. The female has but six ventral arcs, the terminal ones being metamorphosed into the ovipositor and its basal supports.[1] The male abdomen has seven prominent dorsal arcs, with a thin and frequently concealed terminal arc, and seven ventral arcs, the last (hypopygium) being very long, more or less curved upward at the tip,

[1] For structure of this organ in Hymenoptera, see Proc. Ent. Soc. Wash., vol. II, p. 201.

and incloses, with the terminal dorsal arc (pygidium), the claspers and sexual organs. To use these latter in description requires dissection, and they have not, therefore, been referred to.

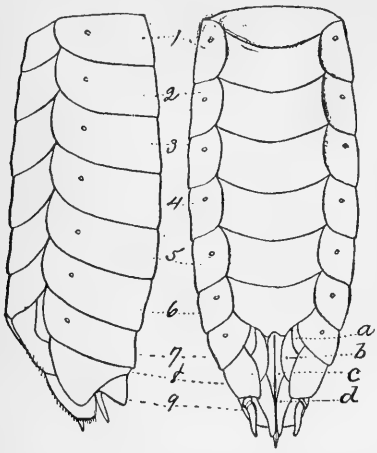

FIG. 5.—Abdomen of *Pachynematus erichsonii*, lateral and ventral views: Segments numbered 1 to 9; *a*, spiculo plate; *b*, basal portion, or support of sheath; *c*, ovipositor; *d*, apical portion of sheath, or sheath proper—enlarged (original).

In the female the sheath of the ovipositor has been referred to throughout the descriptions, and the more prominent variations consist in its width and in the character of the upper and lower margin and of the apex. The hairy vestiture, particularly that of the extreme apex and the lower margin, also presents good specific characters. The cerci are either very short, robust, or spindle-shaped, or are very elongate and slender.

In the males the apex of the seventh dorsal segment and the terminal ventral segment are useful, particularly in generic separation, and also present specific features, particularly in the terminal prolongation from the center of the seventh dorsal segment, which projection, following Konow, is referred to in the descriptions as the procidentia. The narrow projecting tip of this segment is usually thickened and prominent, and varies in its width relative to its length and in the character of the constriction, or otherwise, of its base.

The subject of the venation of Tenthredinidæ has been fully discussed elsewhere and need not be referred to at length here.[1] The normal venation of the Nematines is indicated in the accompanying figure (fig. 6). Of importance in specific characterization are the intercostal cross vein in its relation to the basal vein, and its angle with the costa; the second recurrent vein, as to whether interstitial with the second transverse cubital or received beyond or within the latter; and in the posterior wings, the relation of the outer veins of the discal cells. The shape of the cells of the anterior wings is of comparatively little importance, with the exception of the third cubital, which

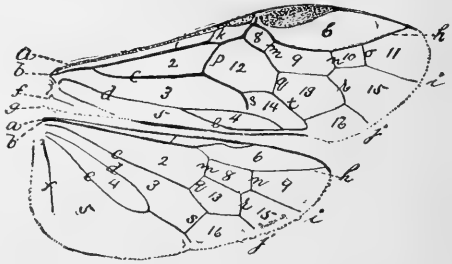

FIG. 6.—NEURATION OF NEMATINES: *Longitudinal veins.*—*a*, costal; *b*, subcostal; *c*, median; *d*, anal; *e*, accessory; *f*, axillary; *g*, inferior; *h*, radial; *i*, cubital; *j*, subdiscal. *Cross veins.*—*k*, transverse costal; *m*, *n*, *o*, first to third transverse cubitals; *p*, basal; *q* and *r*, first and second recurrents; *s* and *t*, first and second transverse medians. *Cells.*—1, costal; 2, subcostal; 3, median; 4, lanceolate; 5, anal; 6, radial; 8–11, first to fourth cubitals; 12–14, first to third discals; 15, 16, first and second posteriors. (In the hind wing cells 8 and 13 are usually termed the discal cells). (Original.)

[1] Proc. Ent. Soc. Wash., III, pp. 78–82.

sometimes presents good specific characters in the matter of its length compared with its width, and of the length, respectively, of its basal and apical cross veins. In a few species the relative length of the discal cells of the hind wings is of importance. In general, however, the neuration of the wings of the Nematines (I refer here more particularly to the genera developed from the old genus *Nematus*) is strikingly uniform—so much so that repeatedly in the descriptions reference is made to what is termed normal venation. This venation will be understood by a reference to the figure which is drawn to represent such venation, and, briefly, consists in the intercostal cross nerve being inclined and about its own length anterior to the basal nerve; the second recurrent being received well within the second cubital cell; the third cubital more than half as wide at base as at apex and about twice as long as wide at base; the upper discoidal cell of the hind wings exceeding the lower and about twice as long as wide. The stigma varies considerably in different genera, and also within the limits of species. This variation relates to its width compared to its length and the character of its apex, whether suddenly or rather obtusely pointed, or distinctly acuminate, and also in the character of its lower border, whether regularly circularly rounded or nearly straight or more or less angulated.

The features of coloration, which have hitherto been used almost exclusively in the differentiation of species, are often constant and furnish reliable characters, but can not be implicitly relied upon. For the ready separation of species and for use in synoptic tables, color will always be more valuable than structural characters, especially to the beginner (see p. 23). The surface characters of the species, such as punctuation and hairy vestiture, are of both specific and generic value, but are less striking and significant in this subfamily than in most of the other divisions or in other families of Hymenoptera.

Secondary sexual characters.—The correct association of the males and females, in the absence of breeding records, is a difficult matter, on account of the striking variation in the sexes in shape, structure of certain parts, and particularly in coloration. The most important secondary sexual characters are: Color, the male being usually much darker than the other sex; form, the male in general being much more elongate; and shape of antennæ, which in the male are commonly very much longer than in the female and frequently compressed basally.

CLASSIFICATION.

The following characteristics distinguish the Nematinæ from allied groups: Antennæ 9-jointed, usually elongate, slender, tapering, rarely with processes on basal joints, frequently more elongate in the males than in the females, and somewhat compressed; anterior wings with simple, seldom-divided radial cell, in which latter case the second cubital receives both recurrent veins; basal nervure converging with

the first recurrent nervure; hind wings always with two discal cells and with complete lanceolate cell.

The following table of genera is based in part on the classification given by F. W. Konow,[1] and it is hoped that it will facilitate the recognition of the new genera, most of which are represented among our North American species.

The revision of genera with redescriptions of old species is limited to the genera formerly included in the genus *Nematus*.

Of the other genera a list of the American species only is given, together with a few notes on synonymy.

TABLE OF GENERA.

Anterior wings with simple radial cell.
  Lanceolate cell widely contracted in the middle.
    Second and third cubital cells each receiving a recurrent vein.
      Third to fifth, sometimes sixth and seventh, antennal joints of the male with a more or less prominent branch at the tip; antennæ of the female somewhat compressed and with sharp projection at tip of basal joints ..... I. *Cladius* Illig.
      Joints of antennæ without projections at tip; third antennal joint curved at the base, in the male with a short, blunt fork beneath, and in the female with a sharp projection ..... II. *Trichiocampus* Htg.
      Antennæ without peculiarities ..... III. *Priophorus* Latr.
    Second cubital cell receiving both recurrent veins.
      Claws bifid ..... IV. *Camponiscus* Newm.
      Claws simple ..... V. *Anoplonyx* gen. nov.[2]
  Lanceolate cell petiolate.
    Third transverse cubital wanting ..... VI. *Euura* Newm.
    Third transverse cubital present.
      Claws bifid, clypeus usually emarginate.
        Tip of the eighth dorsal segment of the male with a small, blunt, more or less awl-shaped, projection; antennæ of female filiform, small species, 2 to 5 mm. long, stigma often having clear base, sheath often pointed at tip, gall inhabiters .. VII. *Pontania* Cost.
        Eighth dorsal segment of male broader, obtusely pointed, or not at all produced at tip; antennæ distinctly tapering toward tip; stigma not lighter at base; sheath not pointed at tip; body more robust.
          Last ventral segment of male obtusely triangularly produced at tip; sheath of female of the usual form; posterior tibiæ simple.
            Mesonotum and pleuræ shining; antennæ long and slender, usually lighter colored beneath; head, viewed from the front, almost round; labium but slightly projecting; sheaths usually narrow and delicate .. VIII. *Pteronus* Jur.

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[1] Deutsche entomologische Zeitschrift for 1890, pp. 225–255.

[2] *Anoplonyx* gen. nov. (*αν*, without; *ὅπλον*, weapon; *ὄνυξ*, claw) is separated from *Camponiscus* Newm. (of which *Leptopus* Hartig is a synonym) by the very important character of a simple claw without branch or inner tooth. The type of both Newman's and Hartig's genus is *Camponiscus luridiventris* Fall., in which the claws are deeply notched, the rays being subequal. *Anoplonyx* will include *Camponiscus pectoralis* Lep., *C. bicolor* Lep., and *C. ovatus* Zadd. The other two species of this genus, *C. auritæ* Z. & B., and *C. carinthiacus* Z. & B., I have not had an opportunity to examine; they may belong with *C. luridiventris* or possibly come in the new genus.

Mesonotum and pleuræ opaque, with very dense and fine punctures; antennæ short, tapering decidedly toward tip; head more or less triangular and with long, projecting labium; stigma narrow, tapering posteriorly, lengthened; sheath rather thick and stout. IX. *Amauronematus* Knw.

Last ventral segment of male excavated at tip, not obtusely triangularly produced; sheath of female very broad or the posterior tibiæ and tarsi thickened.

Posterior tibiæ and tarsi very broad and flattened.

X. *Crasus* Leach.

Posterior tibiæ and tarsi not flattened.

Posterior tibiæ and tarsi thickened, tibiæ externally with longitudinal furrow ..... XI. *Holcocneme* Knw.

Posterior tibiæ and tarsi simple; sheath very thick and stout..... XII. *Nematus* Jur.

Claws with short tooth within tip, tooth projecting nearly at right angle.

Clypeus emarginate.

Vertex with distinct pentagonal area.

XIII. *Pachynematus* Knw.

Vertex without pentagonal area. XIV. *Micronematus* Knw.

Clypeus truncate.

Pentagonal area more or less distinct; eighth dorsal segment carinated, subproduced; sheath simple; elongate species.

XV. *Lygæonematus* Knw.

Pentagonal area wanting; sheath with distinct scopa; first transverse cubital frequently wanting; short, ovate species ..... XVI. *Pristiphora* Latr.

Claws simple, without branch or tooth.

XVII. *Gymnonychus* gen. nov.[1]

Anterior wings with divided radial cell.

Lanceolate cell petiolate..... XVIII. *Dineura* Dahl.

Lanceolate cell contracted..... XIX. *Hemichroa* Steph.

I. Genus CLADIUS Illiger.

Cladius Ill. Fauna Etrusca, 2d ed., p. 27, 1807.

——— *Cladius pectinicornis* Fourcroy. Entom. Paris., II, p. 374, 1785.

Cladius isomera Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 223, 1861.

The only representative of this genus in this country is the well-known enemy of the cultivated rose, described as new by Norton under the name *C. isomera*. An examination some years since of Norton's species in comparison with the European *C. pectinicornis* indicated at once the identity of the two. The common European enemy of the rose had evidently been early imported with rose plants into New England, and the attention of Harris and Norton was drawn to it at a time when comparisons were out of the question, and it was very naturally described as a new species. For a full account of its habits, with figures, see Insect Life, vol. V, p. 6.

[1] From γυμνός, naked, and ὄνυξ, claw.

II. Genus TRICHIOCAMPUS Hartig.

Trichiocampus Htg., Fam. Blattw. u. Holzw., p. 176, 1837.

SPECIES.

gregarius Dyar. Can. Ent., XXVII, p. 191, ♂, 1895.
viminalis Fallen. Svensk. Vet.-Akad. Handl., XXIX, p. 117, 1808.
Aulacomerus lutescens Lintner. 4th Rept. N. Y. State Entom., pp. 94–96, 1888.

III. Genus PRIOPHORUS Dahlbom.

Priophorus Dahl. Conspect. Tenth. Scand., p. 4, 1835.

SPECIES.

æqualis Norton. Trans. Am. Ent. Soc., III, p. 78, ♂, 1872.
simplicicornis Cresson. Trans. Am. Ent. Soc., II, p. 367, ♂, 1869.
solitaris Dyar. Can. Ent., XXVII, p. 192, ♀, 1895.

IV. Genus CAMPONISCUS Newman.

Camponiscus Newm. Entomologist, IV, p. 215, 1869.

No American species.

V. Genus ANOPLONYX Gen. Nov.

No American species.

VI. Genus EUURA Newman.[1]

Euura Newm. Entom. Mag., IV, p. 259, 1837.

SPECIES.

albiricta Cresson. Trans. Am. Ent. Soc., VIII, p. 4, ♀, 1880.
mexicana Cameron. Trans. Ent. Soc. Lond., 1884, p. 482, ♀.
nigra Provancher. Addit. Faun. Can. Hymen., p. 346, ♀, 1888.
orbitalis Norton. Proc. Ent. Soc. Phil., I, p. 144, ♀, ♂, 1862.
salicicola Smith. N. A. Entom., I, p. 41, 1879.
salicis-nodus Walsh. Proc. Ent. Soc. Phil., VI, p. 253, ♂, 1866.
salicis-ovum Walsh. Proc. Ent. Soc. Phil., VI, p. 252, ♀, ♂, 1866.
perturbans Walsh. Proc. Ent. Soc. Phil., VI, p. 254, ♀, ♂, 1866.

VII. Genus PONTANIA Costa.

Pontania Costa. Fauna Napoli, Tenthred., 1859, p. 20.

Body small, smooth, clypeus, emarginate at tip, tarsal claw bifid, stigma usually lighter at base, eighth dorsal segment of male with procidentia produced, narrow, obtusely pointed, more or less awl shaped, black. Female antennæ subfiliform, sheath often pointed. Gall inhabiters. Species three to five millimeters long.

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[1] I have a considerable amount of material in this genus and hope soon to give it a thorough revising. Until this is done, unbred material can not often be satisfactorily placed.

This genus, as characterized above by Konow,[1] includes a group of small Nematines which, so far as their habits have been discovered, breed in galls on the leaves of various species of willow. So far as I am aware, all willow-leaf galls are caused by these insects. The Euuras, which come closest to them in habit, always produce galls in twigs or buds or inhabit twigs without resulting gall formations, and never attack the leaf proper.

The European species, now known as *Pontania gallicola* Steph., is the type of the genus, and was described by Linnæus in 1761 as *Cynips capreæ*, evidently from the gall alone, and was referred to *Cynips* until 1835, when the name *Nematus gallicola* was given it by Stephens, using Westwood's manuscript. The adult insect seems now for the first time to have been characterized. It was subsequently described by Hartig as *Nematus vallisneriæ* (1837), and in 1859 the genus *Pontania* was erected for Hartig's species by Costa. This genus was not very generally adopted until revived by Konow.

The habits of a number of our species have been detailed, notably by Mr. Walsh,[2] and particularly the latter's species—*pomum*,[3] *pisum*, and *desmodioides*. A quantity of material in various species has also been bred at the Department of Agriculture, and the habits of the genus based on these records may be briefly summarized, as follows:

The galls, induced by the egg punctures of the females in young, tender leaves, begin to develop in early summer and are usually globular and fleshy and greenish in color, but later in the season frequently become rosy tinted or brownish. The larva reaches full growth early in the fall (September), and by this time has completely eaten out the interior of the gall, leaving it a mere shell filled with frass. The gall is almost invariably abandoned at this time by the larva, and the species studied at the Department seem to prefer to enter soft or rotting wood or the pith of plants to construct their hibernating cocoons. In the absence of such material they will form cocoons in the earth, and if supplied with neither earth nor wood they will sometimes hibernate within their own galls or enter others of their own species or of other insects. Pupation and transformation to the adult take place in the early part of March and during April, extending into May. Indoors, in breeding cages, where they are subject to unnatural conditions, they may issue as early as February, but this is exceptional.

Mr. F. H. Chittenden, who has reared a number of these insects from cocoons in dead wood of maple, says of the adults (males of *Pontania pisum*) that they are extremely active and pugnacious. "Confined in a small vial, they began to fight at once, and when separated but a single specimen issued from the mêlée in perfect condition, the remainder being minus antennæ and legs."

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[1] Deutsche Entom. Zeitschrift, 1890, p. 237.

[2] See Proc. Ent. Soc. Phila., VI, pp. 248–264; Am. Entom., vol. II, pp. 45–50.

[3] The cumbersome and unnecessary term *salicis* has been omitted in the case of this and the other species to which it has hitherto been prefixed.

The larvæ are rather slender, ranging from 6 to 10 mm. in length, few, however, exceeding 7 or 8 mm. They have apparently 18 feet—6 thoracic and 12 abdominal—the anal pair of abdominal feet being rudimentary. Up to maturity, the body is yellowish white, the head resinous or brownish, tips of mandibles darker, and the eyes, with narrow border, dark brown, almost black. The last joint of the thoracic legs and the claws are resinous. Just before abandoning their galls the larvæ undergo the final molt,[1] assuming a body tint of a dull grayish purple, the head becoming by contrast and in fact of a lighter brown. This obscure coloring is unquestionably a most valuable safeguard against discovery by predaceous insects or birds during the wandering of the helpless, delicate larva in search of hibernating quarters. The cocoon is ovate, of silken threads, more or less agglutinated, thin, and delicate. The life history of *Pontania pisum* Walsh, illustrated in figure 7 (p. 33), is typical of the genus.

The fact noted above, of the habit of the larvæ of entering wood, pith, or other like dry material to pupate, probably explains records made by Walsh and others of certain species which have been designated as inquilinous, either in the galls of other Nematines or in cecidomyiid galls. I am convinced that these records are all doubtful, and that the larvæ of these insects, on abandoning their own galls, had simply entered the others for hibernation. The fact that a species had been reared from a cecidomyiid gall, for instance, was taken as sufficient evidence that it was inquilinous, and a new species was erected. This is illustrated in the case of *Nematus hospes* Walsh, which is said by the describer to be "absolutely indistinguishable from the normal type, the gall-making *Nematus s. pomum*." This species was reared from a gall of *Cecidomyia s. strobiloides* O. S. It is unquestionably identical with *pomum*, and in fact I have recently received from Cornell University two specimens undoubtedly of *pomum*, labeled as having been reared from the cecidomyiid gall referred to. The same is true of *Nematus inquilinus* Walsh, which was reared from the gall of *Cecidomyia rhodoides* Walsh. This species is identical with *Pontania desmodioides* Walsh, and the larva had merely entered the cecidomyiid gall to hibernate.[2]

In going over the material of the Entomological Society of Philadelphia, the accumulations of the United States National Museum, the

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[1] See "Final Moulting of Tenthredinid Larvæ," Proc. Ent. Soc. Wash., vol. II, p. 115.

[2] *Nematus mendicus* Walsh, which was reared from deserted galls of *pomum* and from the leaf galls of *Cecidomyia brassicoides* Walsh, belongs to the genus *Pteronus*. The larvæ apparently entered the galls in question to hibernate, and, with very little doubt, developed exposed on the leaves, as is the case with the other species of *Pteronus* living on willow. *Nematus fur* Walsh, which was bred from the gall of *Cecidomyia batatas* Walsh, seems also not to be a *Pontania*. The type specimen can not be found, but on the authority of Norton it is probably identical with *Nematus luteotergum*, which would bring it within the genus *Amauronematus*.

material submitted by Mr. Gillette, and the Cornell University material, I find 26 good species represented, covering localities practically embracing all temperate America. Of these 8 have been reared from or associated with galls, and two galls are described from which adults have not yet been obtained. The genus is a very difficult one, and the species are, on account of their small size and general similarity, difficult of separation. They are closely related to the following genus (*Pteronus*), and the males in particular are, in some instances, distinguished with difficulty from *Pteronus*. With the females the shape of the sheath furnishes an excellent character for the division of the genus into four groups, and structural characters are available for the ready separation of most of the species. The males, however, are separated with greater difficulty, and frequently where in the other sex two species are most divergent the males are indistinguishable except in comparatively trifling colorational details. Dissection of the sexual organs would probably yield good characters, but this is impossible without destroying the specimens, and would not be practicable for the ordinary student. With the males, therefore, separation of the species is based largely on colorational features. In most cases where males have been associated with females, breeding records are the authority for such references. In general, the males agree with the females in possessing the short, slender, filiform antennæ characteristic of the genus. Two species only, so far as known to me, have very elongate antennæ, and the rather robust, flattened antennæ characteristic of the males of some of the allied genera are very rare in *Pontania*.

In recharacterizing the old species, I have had the specimens themselves before me and have not used the original descriptions at all. Therefore, and particularly in the case of Walsh's species, which were characterized from fresh or living specimens, some divergences in the matter of coloring will be noted by comparison. In general, it may be said that what in the living or fresh specimens is hyaline or greenish white becomes yellow or even ferruginous with drying and age. It seems to me desirable to use the comparatively permanent color characters presented by the dry specimens rather than the transitory coloring of the newly emerged insect.

A number of parasites and inquilinous insects of other orders have been reared from the galls, but it is not definitely ascertained in every case whether the hosts of the former are the gall makers or the inquilinous insects. Mr. Walsh reared a little curculionid, *Anthonomus sycophanta* Walsh, from the galls of *pomum*, *desmodioides*, and *Euura nodus* Walsh. A small tineid, *Batrachedra s. pomonella* Clem., was reared by Walsh from the galls of *pomum*, *desmodioides*, and a cecidomyiid gall, *C. s. rhodoides*. The Department rearings from galls include a dipterous insect, undetermined, and two chalcidids, one a species of *Sympiesis* and the other *Eurytoma studiosa* Say, both probably parasitic on *Anthonomus sycophanta*, which was reared from the same galls.

Bassus euura Ashm. has been reared from *Pontania resinicola*, and *Pimpla euura* Ashm. from *Pontania pyriformis*. These last are undoubtedly parasitic upon the larvæ of the gall makers.

TABLE OF SPECIES.

Females.

Sheath broad at base, sharply acuminate at tip, and emarginate beneath I
Sheath as above, except that the tip is obtusely rounded II
Sheath broad and rounded at tip, scarcely tapering III
Sheath narrow, elongate, regularly tapering to somewhat pointed tip IV

I. Color in general black.
Head, thorax, abdomen, and femora black; tegulæ and mouth parts pale. 1. *cressoni* n sp.
Same, except that angles of pronotum are yellow and the femora are pale laterally ..... 2. *parva* Cr
Same, except that pronotum and legs are whitish and the orbits are broadly yellow except on narrow inner margin ..... 3. *nigrita* n. sp.
Same as last, except that orbits are entirely yellow; antennæ yellow beneath and sheath but slightly emarginate ..... 4. *pallicornis* Nort.
Color in general luteous.
Claws very minutely cleft at tip.
Central lobe of metanotum black; outer veins of posterior discals not interstitial ..... 5. *agilis* Cr.
Central lobe pale; outer veins interstitial ..... 6. *mellina* Cr.
Claws coarsely notched ..... 7. *nevadensis* Cr.
II. Color black ..... 8. *excavata* n. sp.
Color in general resinous.
Frontal crest well developed.
Stigma broad, rounded on lower margin.
Crest bulbous; pectus pale ..... 9. *resinicola* n. sp.
Crest narrow; pectus black ..... 10. *pectoralis* n. sp.
Stigma narrow, acuminate ..... 11. *acuminata* n. sp.
Frontal crest obsolete ..... 12. *robusta* n. sp.
III. Color in general black.
Orbits black; stigma narrow elongate ..... 13. *kincaidi* n sp.
Orbits broadly yellow; stigma brown ..... 14. *pisum* Walsh.
Orbits posteriorly yellow; stigma yellow ..... 15. *bruneri* n. sp.
Color in general resinous.
Mesonotum black, except scutellum; sheath broad, paddle shaped. 16. *pacifica* n. sp.
Mesonotum mostly pale; sheath somewhat blade shaped. 17. *pomum* Walsh.
IV. Clypeus nearly truncate, or very broadly and shallowly emarginate.
Pronotum and venter of abdomen black.
Tegulæ black ..... 18. *atra* n. sp.
Tegulæ pale ..... 19. *hyalina* Nort.
Pronotum and venter of abdomen pale ..... 20. *truncata* n. sp.
Clypeus distinctly and more narrowly emarginate.
Dorsum of thorax and abdomen black.
Orbits black, or rarely slightly reddish brown.
Venter of abdomen black ..... 21. *atriventris* n. sp.
Venter of abdomen pale ..... 22. *californica* n. sp.
Orbits broadly yellow.
Stigma and costa brown ..... 23. *gracilis* n. sp.
Stigma and costa hyaline ..... 24. *stigmatalis* n. sp.

Dorsum of thorax and abdomen marked with yellow.
Orbits, scutellum, and lobes of thorax more or less yellow; robust species ..... 25. *desmodioides* Walsh.
Same, with yellow transverse bands on abdomen, and venter altogether yellow ..... 26. *sulphurea* n. sp.

Males.

Antennæ as long as or longer than the body of the insect.
Claws very minutely divided ..... 5. *agilis* Cr.
Claws coarsely notched ..... 7. *neradensis* Cr.
Antennæ not often exceeding one-half the body in length.
Black species.
Orbits black, rarely slightly rufous posteriorly.
Pronotum black; stigma short, robust ..... 22. *californica* n. sp.
Pronotum black; stigma elongate, narrow ..... 13. *kincaidi* n. sp.
Pronotum with pale margins.
Lateral walls of ocellar basin rounded or subobsolete.
Third and fourth joints of antennæ of equal length.
Hind femora pale ..... 9. *resinicola* n. sp.
Hind femora more or less dark ..... 2. *parva* Cr.
Third joint longest ..... 27. *rugulosa* n. sp.
Lateral walls of ocellar basin sharply defined ..... 8. *excavata* n. sp.
Orbits yellow; body black dorsally.
Venter of abdomen, except centrally, black; vertex hairless, shining. 14. *pisum* Walsh.
Venter with vertex clothed with yellowish hairs. 25. *desmodioides* Walsh.
Venter of abdomen altogether pale.
Epimera black.
Outer angles of pronotum pale ..... 17. *pomum* Walsh.
Pronotum altogether pale ..... 4. *pallicornis* Nort.
Epimera pale.
Body robust; stigma pale ..... 12. *robusta* n. sp.
Body elongate; stigma brown.
Claws very minutely cleft at extreme tip. 28. *placenta* Nort.
Claws coarsely notched ..... 29. *pallifrons* Cr.
Resinous; vertex, mesonotum, metanotum, and basal abdominal segments centrally black ..... 26. *sulphurea* n. sp.

Table of galls.

Galls springing from lower side of leaf.
Conical or pear shaped ..... 30. *pyriformis* n. sp.
Globular, attached minutely ..... 14. *pisum* Walsh.
Globular, broadly attached.
Singly on either side of midrib ..... 17. *pomum* Walsh.
In rows on or near midrib ..... 31. *monile* n. sp.
Galls bisecting leaf.
Singly, or rarely more than two on leaf.
Usually remote from petiole; averaging three-eighths inch long; on *Salix longifolia* ..... 15. *bruneri* n. sp.
Near or joining petiole; averaging one-half inch long.
Approaching shape of seed of Desmodium:
On *Salix californica?* ..... 22. *californica* n. sp.
On *Salix humilis?* ..... 25. *desmodioides* Walsh.
On *Salix* sp ..... 2. *parva* Cr.
More robust, approaching globular ..... 23. *gracilis* n. sp.

Many together on leaf.

Paired at base of blade of leaf; extending from middle to edge.

9. *resinicola* n. sp.

Distributed irregularly along blade on either side of midrib, rarely on edge of leaf ..... 19. *hyalina* Nort.

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acuminata n. sp. ♀ 11
agilis Cr. ♂ ♀ 5
atra n. sp. ♀ 18
atriventris n. sp. ♀ 21
bruneri n. sp. ♀ 15
californica n. sp. ♂ ♀ 22
cressoni n. sp. ♀ 1
desmodioides Walsh ♂ ♀ 25
excavata n. sp. ♂ ♀ 8
gracilis n. sp. ♀ 23
hyalina Norton ♀ 19
kincaidi n. sp. ♀ 13
mellina Cr. ♀ 6
monile n. sp. (gall) 31
nevadensis Cr. ♂ ♀ 7
nigrita n. sp. ♀ 3
pacifica n. sp. ♀ 16
pallicornis Norton ♂ ♀ 4
pallifrons Cr. ♂ 29
parva Cr. ♂ ♀ 2
pectoralis n. sp. ♀ 10
pisum Walsh ♂ ♀ 14
placenta Norton ♂ 28
pomum Walsh ♂ ♀ 17
pyriformis n. sp. (gall) 30
resinicola n. sp. ♂ ♀ 9
robusta n. sp. ♂ ♀ 12
rugulosa n. sp. ♂ 27
stigmatalis n. sp. ♀ 24
sulphurea n. sp. ♂ ♀ 26
truncata n. sp. ♀ 20

cressoni Marl.

1. Pontania cressoni new species.

Female.—Length 4.5 mm.; not very robust; clypeus deeply emarginate; lobes small, pointed; ocellar basin distinctly defined, breaking rather broadly into prominent antennal fovea; antennæ normal, third joint a little longer than fourth; sheath acuminate, emarginate beneath; claws deeply cleft; venation normal, except that outer veins of discal cells of posterior wings are interstitial. Color black, shining, including pronotum, orbits, and femora; tegulæ, mouth parts, tibiæ and tarsi pale, more or less infuscated, especially at tips of posterior tibiæ and their tarsi; wings nearly hyaline; stigma and costa brown, the former hyaline at base.

One female, Washington. (Coll. Am. Ent. Soc.)

2. Pontania parva Cresson.

1880. *Nematus parvus* Cresson. Trans. Am. Ent. Soc., VIII, p. 5.

Female.—Length 3.5 to 4 mm.; not robust; clypeus shallowly and broadly exavated; lobes short, minute; mouth parts with very long and rather numerous light hairs; lateral furrows of vertex very broad and deep; ocellar basin distinctly defined; frontal crest indistinct, broken by the broad, oval, deeply excavated antennal fovea; antennæ very slender, joints 4 and 5 as long as or longer than 3; sheath strongly acuminate at tip, circularly emarginate beneath, rounded above; cerci tapering; claws small, deeply and finely notched, rays almost parallel; venation normal. Color black, shining; mouth parts, spot beneath antennæ, outer third of pronotum, tegulæ, apices of coxæ, trochanters, and legs for the most part yellowish; upper and lower margins of femora, tips of tibiæ, particularly

posterior pair, and tips of tarsi, including all of posterior pair, reddish brown; all of legs somewhat infuscated; veins brown; basal half of stigma and extreme base of costa pale; in some specimens the legs beyond the trochanters are altogether light, except posterior tibiæ and tarsi.

Male.—Length 3.5 mm.; agrees with the female in general structure and colorational characters; lateral walls of ocellar basin more flattened and rounded; the stigma uniformly brownish; the antennæ distinctly fulvous beneath.

Gall.—Length 8 mm.; breadth 6 mm. Of type of *desmodioides*, but rather smaller and projecting most on lower surface of leaf. In the specimen examined, two occur on the leaf, one on either side of the midrib, and each extends from the latter to the margin of the leaf. Surface, especially lower, tuberculate and rosy. Exit hole of adult on lower side, just at surface of leaf and at end next to petiole.

Ten females.—Nevada 4, California 3, Oregon 2, and Arizona and Montana 1 each. (Coll. Am. Ent. Soc.) Also one specimen collected by T. Kincaid at Olympia, Wash. (Coll. Cornell Univ.) One male from California. (Coll. Am. Ent. Soc.) Galls on willow leaf collected by Mr. Ehrhorn, Mountain View, Cal. Two adults reared, which, with galls, are in collection of William H. Ashmead.

3. **Pontania nigrita** new species.

Female.—Length 4 mm.; clypeus circularly excavated; lobes rounded; mouth parts with rather long, whitish hairs; walls of ocellar basin distinctly defined; frontal crest somewhat broken by the very elongate, distinctly limited antennal fovea; antennæ with joints 3 to 5 subequal; sheath broad, strongly acuminate at tip; cerci robust, tapering; claws deeply notched, rays nearly equal; third cubital cell quadrate, not longer than wide; outer veins of discal cells of hind wings interstitial. Color black, shining; face below antennæ, posterior and upper orbits, most of pronotum, tegulæ, all of legs except extreme bases of posterior coxæ and extreme bases of posterior tibiæ whitish or resinous; tips of posterior tarsi and tips of cerci dusky; bases of all wing veins reaching the body and extreme base of stigma light; balance of veins brown.

One female. Michigan. (Coll. U. S. Nat. Mus.)

4. **Pontania pallicornis** Norton.

1861. *Nematus pallicornis* Norton. Boston Proc., VIII, p. 160.
1867. *Nematus pallicornis* Norton. Trans. Am. Ent. Soc. I, p. 203 (Cat., etc., p. 65).

Female.—Length 5 mm.; somewhat robust; clypeus circular and moderately broadly notched, lobes small; mouth parts with scattering whitish hairs; vertex roughened; ocellar basin distinctly defined; frontal crest strongly developed, very slightly broken by the antennal fovea,

which is oval and not deeply excavated; antennæ short, scarcely tapering; sheath rather broad, acuminate, but not very sharply pointed, hairs rather long and abundant; cerci pointed; claws very large, deeply cleft; venation about normal; intercostal vein nearly at right angles with costa, and outer veins of discal cells of hind wings interstitial, or nearly so. Color black, shining; face below antennæ, orbits, mouth parts, angles of pronotum, tegulæ, and legs, except extreme bases of coxæ, yellowish ferruginous; antennæ ferruginous beneath, especially toward apex; veins light brown; base of stigma and base of costa pale; abdomen inclined to rufous beneath.

Male.—Length 4.5 mm.; antennæ much longer and antennal fovea somewhat narrower than in female; tip of abdomen strongly recurved; color as in female, except that bases of posterior coxæ only are black, and the abdomen ventrally with more or less of the apex of the last dorsal segment is yellowish ferruginous. The antennæ also are almost altogether yellowish, except scape and basal joints of the flagellum above.

Five females and five males. Illinois, Texas, and New Hampshire. (Colls. Am. Ent. Soc. and U. S. Nat. Mus.)

5. Pontania agilis Cresson.

1880. *Nematus agilis* Cresson. Trans. Am. Ent. Soc., VIII, p. 9.

Female.—Length 5 mm.; very robust; clypeus broadly and shallowly excavated; lobes minute, rounded; vertex elevated, but with ocellar basin not very distinctly limited; ridges rounded; frontal crest not distinctly raised; antennal fovea circular, shallow; claws very minutely and microscopically cleft at extreme apex; sheath strongly acuminate, broad basally; cerci tapering; venation normal. Color yellowish ferruginous, resinous, shining; antennæ, spot including ocelli, small circular spot on occiput, stripe on each of the lobes of mesothorax, base of scutellum, metathorax, more or less of first segment of abdomen, black; veins yellowish brown; stigma and costa yellow, the former edged with brown at tip.

Male.—Length 4 to 4.5 mm.; very slender, graceful; head and mouth parts about as in female; antennæ very long, slender, longer than entire body; claws cleft as in female. Color: Large spot on vertex, extending considerably beyond ocelli and backward over occiput, mesothorax, metathorax, abdomen, dorsally except sides of the terminal segments, scape and flagellum above, black; balance of insect, including venter, legs, lower surface of antennæ, except extreme tip, yellowish ferruginous; veins brown; stigma yellow, edged with brown.

One female and five males. Nevada and Washington. (Coll. Am. Ent. Soc.)

6. Pontania mellina Cresson.

1880. *Nematus mellinus* Cresson. Trans. Am. Ent. Soc., VIII, p. 10.

Female.—Length 5.5 mm.; very robust, shining; clypeus distinctly but rather broadly emarginate; lobes short, broad, rounded; ocellar basin deeply excavated; sides and frontal crest strongly raised, but rather thick and rounded, the former somewhat broken; antennal fovea deep, not sharply defined; antennæ scarcely longer than head and thorax, slender, joints 3 and 4 subequal; venation in general normal; intercostal very near basal; the outer veins of discal cells of hind wings interstitial; stigma not very broad, tapering from oval base circularly to apex; sheath sharply acuminate, fringed with rather long hairs; cerci long, scarcely tapering; claws very minutely notched at extreme apex. Color yellowish, tinged with ferruginous, a little darker around vertex, mesonotum, and mesepimera; antennæ, small spot about ocelli, sometimes limited to ring about each ocellus, minute spot on occiput, spot on lateral lobes of mesonotum, on either side of mesoscutellum, apex of latter, and most of metanotum except basal plates black; dorsal margin and tip of sheath brownish; veins yellowish brown; stigma and costa yellow, unicolorous.

Two females. Nevada. (Coll. Am. Ent. Soc.)

This species, though somewhat larger, is very closely allied to *agilis* Cresson.

7. Pontania nevadensis Cresson.

1880. *Nematus nevadensis* Cresson. Trans. Am. Ent. Soc., VIII, p. 9.

Female.—Length 4.5 to 5 mm.; very robust, shining; vertex slightly roughened; clypeus broadly, shallowly excavated; hairs of clypeus and labrum almost wanting; sides of ocellar basin very sharply raised; frontal crest large, distinct, unbroken; antennal fovea circular, rather deeply excavated; antennæ short, not as long as head and thorax, joint 3 very slightly longer than 4 and 5; sheath broad basally, strongly acuminate; cerci moderate, tapering; claws very large, deeply cleft. Color sulphur yellow; antennæ, quadrate spot on vertex, extending back over occiput with lines running to base of antennæ, mesonotum, metanotum, and stripe on basal segments of the abdomen becoming obsolete after the fourth or fifth segment black; spot beneath base of wings and upper margin and apex of sheath brownish black; antennæ inclined to fulvous beneath toward tips; veins yellowish brown; stigma lighter, except lower apical margin; costa lighter at base.

Male.—Length 4.5 mm.; very slender, graceful; antennæ nearly as long as entire body, joints 3 to 5 subequal, fourth a little longer than third; procidentia projecting about half its length; legs long; claws not very large, but deeply cleft. Color resinous yellow, inclined to ferruginous on the thorax beneath; antennæ above at base and scape,

large spot on vertex extending over occiput, mesonotum, metanotum, broad stripe on each dorsal segment of abdomen, not extending to lateral or posterior margin, black, inclining to brown on abdomen; veins light yellowish brown; stigma almost hyaline.

Three females and three males. Nevada, California, Montana, and Vancouver Island. (Colls. Am. Ent. Soc. and U. S. Nat. Mus.)

The male from Montana was placed by Cresson with his types of *agilis*, from which it is easily separated by the character of the claws, and from general structural characters may be safely referred to *nevadensis*.

8. **Pontania excavata** new species.

Female.—Length 4 mm.; moderately slender, glistening; clypeus narrowly and rather deeply incised; lobes rounded; mouth parts with rather long hairs; walls about ocellar basin distinctly defined; frontal crest widely broken by the extension of the shallow antennal fovea posteriorly into ocellar basin; antennæ short, joints 3 to 5 subequal, third slightly longest; sheath rather robust, strongly convex on upper margin and distinctly excavated on lower, acuminate but not sharply pointed, hairs long, scattering; claws deeply divided, rays equal and scarcely divaricating; intercostal vein nearly interstitial with basal, very slightly inclined; second recurrent interstitial with second transverse cubital. Color black; mouth parts, extreme angles of pronotum, tegulæ, tips of coxæ, and balance of legs for the most part resinous; upper and lower edges of femora, tips of posterior tibiæ, and tips of tarsi, extending on the posterior pair to the tip of the basal joint, brownish; antennæ somewhat lighter beneath, especially toward tip; veins yellowish brown; stigma at base and costa at base and apex hyaline.

Male.—Agrees in general with the female; ocellar basin even more sharply defined and the frontal crest unbroken; venation normal. Color as in female, except that the legs are lighter and the central portion of the abdomen beneath is inclined to yellowish; antennæ distinctly fulvous beneath; joints long, nodose at tips.

Four females and one male. California, Colorado (C. P. Gillette), and Veta Pass, Colo. (Colls. U. S. Nat. Mus. and Am. Ent. Soc.)

9. **Pontania resinicola** new species.

Female.—Length 5.5 mm.; rather robust; clypeus deeply, angularly emarginate; lobes triangular, rounded at tips; mouth parts with very few and inconspicuous hairs, shining; frontal crest very broadly and bulbously elevated, semicircular, shallowly notched at center; ocellar basin not distinctly limited laterally, or lateral walls wanting; antennal fovea elongate; antennæ short, filiform, third joint longest; claws deeply bifid, rays nearly parallel; sheath moderately broad, very slightly sinuate on lower margin, tapering regularly to apex, armed

with rather long, curved hairs; cerci long, slightly tapering; upper discal cell of hind wings usually much shorter than lower and terminating within apex of latter. Color resinous yellow; quadrate spot on vertex, broad stripe on dorsum of thorax extending to scutellum, metanotum and more or less of basal segments of abdomen centrally decreasing posteriorly, and upper margin of sheath brownish-black; scape and upper half of antennæ, tips of mandibles, and balance of sheath fuscous; veins brown, costa and stigma centrally yellow.

Male.—Length 4 mm.; rather slender, tapering distinctly from head and thorax to tip of abdomen; structurally, as in the female, with the lateral walls of the ocellar basin perhaps even less apparent—practically obsolete. Color black, shining, including orbits; mouth parts, angles of pronotum, tegulæ, and legs brownish yellow; tips of posterior tibiæ and tarsi somewhat infuscated; antennæ beneath fulvous; veins, including all of stigma and costa, rather dark brown; wings hyaline.

Gall.—(Frontispiece, fig. 1.) On leaves of *Salix californica* collected by Albert Koebele at Donner, Placer County, Cal., September 5, 1885. The galls occur in clusters of two to eight on the basal portion of the leaf, beginning usually at the very apex of the petiole. They are commonly paired—if but two, one on either side, or two or four on a side, as the case may be—occasionally occurring singly. In general size and appearance the individual galls resemble those of *desmodioides*, but are rather more robust or globular, projecting equally on both sides of the leaf and occupying the leaf entirely from the midrib to the edge. Where two or more occur together, they are merged into each other, forming a compound gall. In color they are red or pink on the upper side and light yellowish green on the lower. The larva is large and rather robust, indicating a fairly good-sized insect. I have doubtfully referred the gall to *Pontania resinicola*, the largest Californian representative of the genus, although the galls from which the adults were reared by Mr. Koebele were not saved by him and the ones sent to Washington yielded only an ichneumonid parasite (*Bassus euuræ* Ashm., Ins. Life, vol. III, p. 460) and a tortricid.

Two females and seven males. Albert Koebele, Los Angeles, Cal. (Coll. U. S. Nat. Mus.)

10. Pontania pectoralis new species.

Female.—Length 5 mm.; rather robust; clypeus very broadly and shallowly emarginate; frontal crest and sides of ocellar basin sharply and distinctly defined, former unbroken; antennal fovea broad oval; fourth joint of antennæ a little longer than third; claws deeply notched, rays nearly equal; sheath of ovipositor stout and broad basally, slightly emarginate on lower apical edge, tip obtusely rounded; cerci short, tapering; third cubital three times as long as wide at base; outer veins of discal cells of posterior wings nearly interstitial; stigma very broad basally, regularly tapering to pointed apex. Color

in general resinous; base of antennæ, space about ocelli, stripe on each lobe of mesonotum, apex of scutellum, metanotum, dorsal segments of abdomen, except last, extending over sides to ventral arc, large spot on pectus, and sheath, especially dorsally, brownish black; outer two-thirds of antennæ reddish brown; tips of posterior tibiæ and all the tarsi, slightly darker; wings hyaline; veins light yellowish brown; base of stigma hyaline.

One female. Algonquin, Ill. (Coll. Cornell Univ.)

11. **Pontania acuminata** new species.

Female.—Length 5.5 mm.; rather robust; abdomen strongly tapering from just beyond middle; clypeus rather shallowly, somewhat angularly, notched; vertex coarsely punctured and roughened; frontal crest prominent, broadly curved, almost straight; sides of ocellar basin low, but well defined; antennal fovea shallow, indistinct, expanding apically; antennal joints, 3 and 4 subequal; intercostal vein at right angles with costa; stigma very elongate, narrow, distinctly acuminate; sheath broad, slightly concave on upper margin, and decidedly produced at tip, which is obtusely pointed, and with rather dense tuft of hairs; cerci robust, but slightly tapering; claws deeply cleft, rays subequal. Color: Antennæ, spot on head back of ocelli and extending over occiput, center of lobes of mesonotum, apical half of scutellum, metanotum and basal plates, more or less of abdomen basally and centrally to apex, sheath, and sides of the metathorax black; mesepimera reddish brown; posterior tibiæ and tarsi strongly infuscated, anterior tarsi less so; body generally otherwise reddish ferruginous, somewhat infuscated; mouth parts, angles of pronotum, tegulæ and anterior legs and base of all legs, yellowish; veins, including stigma and costa nearly to base, dark brown.

One female. Michigan. (Coll. U. S. Nat. Mus.)

12. **Pontania robusta** new species.

Female.—Length 4.5 mm.; very robust; clypeus not very deeply emarginate, lobes broad, rounded; ocellar basin with not very distinct lateral walls, broadly uniting with very large, shallow antennal fovea, the two depressions appearing almost as one; antennæ short, joint 4 a little longer than 3; sheath short, broad, rounded at tip, emarginate beneath; venation normal, except that outer veins of posterior discal cells are interstitial; claws rather deeply cleft, rays parallel. Color in general resinous yellow, shining; antennæ above, quadrate spot on vertex, including ocelli and extending over occiput, quadrate spot on the center of mesonotum, line down center and the tip of the scutellum, together with the dorsum of the abdomen, except lateral margins, brownish black; antennæ fulvous beneath; mouth parts whitish, with the tips of the mandibles reddish brown; wings hyaline; veins brown,

costa and stigma very light, almost hyaline, the latter with narrow brown bordering line.

Male.—As in female, except that the occiput is infuscated and the mesothorax is entirely black.

One female and one male. Michigan and District of Columbia (?). (Coll. U. S. Nat. Mus.)

13. **Pontania kincaidi** new species.

Female.—Length 6 mm.; rather robust, shining; clypeus very broadly but not deeply emarginate; ocellar basin with distinctly defined walls;

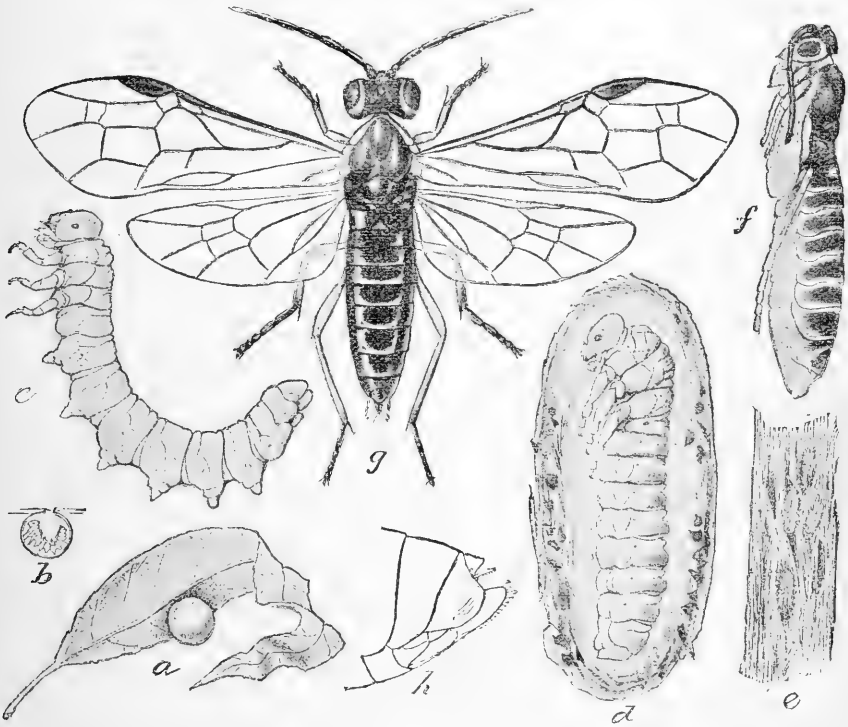

FIG. 7.—*Pontania pisum* Walsh: *a* and *b*, gall; *c*, larva; *d*, same, in contracted dormant state in cocoon; *e*, cocoons in barks, *f*, pupa; *g*, adult female; *h*, lateral view of tip of abdomen of same; *a*, *b*, and *e*, natural size; rest enlarged (original).

crest very prominent, curved forward, unbroken; antennal fovea extending laterally over base of antennæ; antennæ short, joints regularly diminishing in length from third to tip; venation normal; stigma narrow, elongate, acuminate; sheath scarcely tapering, rounded at tip; claws deeply and coarsely notched. Color black, shining; clypeus and mouth parts, extreme angles of pronotum, tegulæ and legs yellowish ferruginous, decidedly infuscated; wings hyaline or very slightly clouded; veins dark brown; stigma a little lighter toward base.

Four females. Trevor Kincaid, Olympia, Wash. (Coll. Cornell Univ.)

14. Pontania pisum Walsh (fig. 7.)

1866. *Nematus salicis pisum* Walsh. Proc. Ent. Soc. Phila., VI, p. 259.
1866. *Nematus quercicola* (Walsh) Cresson. Proc. Ent. Soc. Phila., VI, p. 260.
1867. *Nematus salicis pisum* Norton. Trans. Amer. Ent. Soc., I, p. 204. (Cat., etc., p. 66.)
1880. *Nematus salicis pisum* Thomas. 10th Rep. State Ent. Ill., p. 68.
1895. *Nematus pisum* Marlatt. Proc. Ent. Soc. Wash., III, p. 264.
1895. *Nematus quercicola* (Walsh) Marlatt. Proc. Ent. Soc. Wash., III, p. 266.

Female.—Length 4 mm.; slender, head wider than thorax; abdomen spindle shaped; clypeus rather deeply and angularly notched, lobes triangular; ocellar basin distinctly limited, lateral ridges not very sharply raised; frontal crest prominent, slightly notched at center; antennal fovea shallow, elongate; antennæ short, moderately robust, joints 3 to 5 subequal; sheath broad, very slightly emarginate beneath, rounded above, apex rounded; cerci rather long, tapering; claws deeply notched, rays subequal; third cubital cell quadrate; upper discal cell not exceeding lower. Color: Antennæ, spot on vertex extending more or less over occiput, thorax, most of abdomen, including sheath, black; orbits and face below and including frontal crest, most of pronotum, tegulæ, legs except extreme base of posterior coxæ, more or less of central portion of venter of abdomen, including all terminal segments and the terminal dorsal segment with cerci, yellowish ferruginous; tips of posterior tibiæ and tarsi infuscated; antennæ very slightly paler beneath and toward tips; veins and stigma brown; costa lighter at base.

Male.—Length 3.5 mm.; very slender and graceful; antennæ longer than in female and more robust; joints 3 to 5 subequal. Color black; face below frontal crest, orbits, angles of pronotum, tegulæ, legs except bases of posterior coxæ, central portion of abdomen beneath, and hypopygium yellow; veins as in female; antennæ fulvous beneath and also entirely at apex.

"*Gall.*—The gall made by it is found on *Salix discolor*. A subspherical, pea-like, hollow, pale yellowish-green gall, always growing on the underside of the leaf and almost always from one of the side veins (in one case from the midrib), and attached to the leaf by only a minute portion of its surface; 0.18 to 0.28 inch in diameter, and a few, immature, only 0.08 inch in diameter. Almost invariably there is but one gall to the leaf, but on four leaves there were two, and occasionally two are confluent. Surface in some smooth and even, without pubescence; in others a little shriveled, generally studded in the medium-sized ones with four to twelve small, robustly conical nipples, which in the larger ones have burst into a scabrous brown scar. Only in three out of sixty-two was there any rosy cheek, as in *s. pomum*. The point of attachment is marked on the upper side of the leaf by a brown subhemispherical depression.

"*Larva.*—August 25. Apparently 18-footed, no anal prolegs being visible. When at rest, it elevated its entire abdomen behind the true legs in the air. Length 0.17 to 0.23 inch; color whitish hyaline; head slightly dusky; mouth dusky; eye-spots circular and black; anal segment equal in length to two of the others and apparently divided in two by a transverse medial suture. The larva goes under ground to transform, for out of fifty galls all but three were bored, and in those, when opened, larvæ which had perished when immature were found."—Walsh, Proc. Ent. Soc. Phila., VI, p. 259.

Four females and five males. Illinois and New York. (Colls. Am. Ent. Soc. and U. S. Nat. Mus.)

Galls: Richfield Springs, N. Y., Th. Pergande, collector, September 22, 1886; adults (males) issued January 27 to February 5, 1887. East Steamburg, N. Y., E. L. Horton, collector, September 25, 1894; adult issued March 28, 1895.

15. **Pontania bruneri** new species.

Female.—Length 4.5 mm.; moderately robust; abdomen much broader than thorax; clypeus distinctly but broadly emarginate, lobes small; lateral walls of ocellar basin rounded, indistinct; frontal crest very slightly broken, prominent; third and fourth joints of antennæ subequal; sheath broad, scarcely tapering, somewhat obliquely rounded at tip; second recurrent interstitial with second cubital; third cubital indistinct; upper discal of posterior wings considerably shorter than lower. Color black, shining; mouth parts, posterior orbits, angles of pronotum, tegulæ, legs except bases of coxæ, brownish yellow; veins light brown; stigma and costa yellowish, the former nearly hyaline basally. The abdomen in one specimen is yellowish beneath at apex.

Gall.—(Frontispiece, fig. 7.) Galls occurring singly on the edges of the leaves of *Salix longifolia*, having the form and general characteristics of the gall of *P. desmodioides*. Length from 7 to 10 mm.; smooth, fleshy gall, extending from the midrib considerably beyond the narrow, linear leaf, with a prominent and distinct suture indicating what was the edge of the leaf; in color yellowish, inclined to reddish.

Three females, reared from galls collected by Lawrence Bruner on Robinson's ranch, Wyoming, September 15, 1881. The galls at this time were mostly abandoned, only six of them still containing larvæ. Adults issued between February 18 and March 3, 1882. (Coll. U. S. Nat. Mus.)

16. **Pontania pacifica** new species.

Female.—Length 5 mm.; rather robust; clypeus broadly, circularly emarginate, lobes medium; frontal crest very strongly developed, broken; lateral walls of ocellar basin subobsolete; antennæ with joint 3 very little longer than 4; sheath broad, not tapering, broadly rounded at tip; claws deeply cleft; venation normal, except that the upper discal does not exceed the lower. Color in general resinous; antennæ, large spot on vertex, including ocelli, occiput, mesonotum except scutellum, metanotum and the basal segment of abdomen, lower half of mesepimera, and sheath brownish black; veins dark brown; stigma somewhat lighter basally; wings very slightly infuscated.

One female. Southern California. (Coll. Am. Ent. Soc.)

17. Pontania pomum Walsh.

1866. *Nematus salicis pomum* Walsh. Proc. Ent. Soc. Phil., VI, p. 255.
1866. *Nematus hospes* Walsh. Proc. Ent. Soc. Phil., VI, p. 261.
1867. *Nematus salicis pomum* Norton. Trans. Amer. Ent. Soc., I, p. 216. (Cat., etc., p. 78.)
1867. *Nematus hospes* Norton. Trans. Amer. Ent. Soc., I, p. 218. (Cat., etc., p. 80.)
1869. *Nematus salicis pomum* Walsh and Riley. Am. Ent., II, p. 45.
1877. *Nematus salicis pomum* Riley. 9th Rept. Ins. Mo., p. 20.
1881. *Nematus salicis pomum* Thomas. 10th Ent. Rept. Ill., p. 68.
1882. *Nematus salicis pomum* Provancher. Nat. Can., XIII, p. 292.
1883. *Nematus salicis pomum* Provancher. Nat. Can. Hym., p. 741.
1895. *Pontania hospes* Marlatt. Proc. Ent. Soc. Wash., III, p. 266.

Female.—Length 5 to 5.5 mm.; very robust, shining; clypeus rather deeply, but angularly emarginate, lobes triangular, rounded; ridges of vertex about ocellar basin rounded, subobsolete; frontal crest broad, rounded, slightly notched; antennal fovea very shallow, elongate; antennæ short, not longer than head and thorax, joint 3 a little longer than 4 or 5; sheath very broad and robust, scarcely tapering, rounded at tip; cerci rather long, tapering; claws not very deeply cleft, inner ray much shorter than outer; venation normal, except that outer veins of the discal cells of hind wings are usually interstitial. Color yellowish ferruginous; antennæ, quadrate spot inclosing ocelli, with branches running to base of antennæ, stripe on center of mesonotum extending to mesoscutellum, spot on either side of scutellum and thorax posterior to same, with basal plates and narrow basal margin of the dorsal segments becoming indistinct toward tip of abdomen, and sheath brownish black; antennæ indistinctly rufous beneath toward tips; posterior tarsi slightly infuscated at tips; veins brown; stigma and costa more inclined to yellowish, former not especially lighter at base; black stripe on mesonotum is sometimes interrupted or occasionally almost wanting.

Male.—Length 4 mm.; more slender and elongate than female; structurally as in female, except that the antennæ are longer; joints 3 to 5 subequal. Color brownish black, shining; head and thorax opaque from rather coarse puncturing; face below base of antennæ, orbits, angles of pronotum, tegulæ, legs except bases of coxæ, and abdomen beneath yellowish ferruginous; tips of anterior tarsi and all posterior tarsi fuscous; antennæ rufous beneath, especially toward tips; wings as in female, but slightly darker.

Gall.—(Frontispiece, fig. 4.) The gall *s. pomum* found on *Salix cordata* and very rarely on *S. discolor*. A smooth, fleshy, sessile, globular, or slightly oval monothalamous gall, like a miniature apple, 0.30 to 0.55 inch diameter, growing on one side of the midrib of a leaf, and extending to its edge or beyond it. The principal part of the gall projects from the under side of the leaf; very rarely it is bisected by the leaf. Color greenish yellow, sometimes with a rosy cheek, especially the upper surface, and often with little dots. Fully mature July 31. An analogous gall is formed in Europe on various willows by *Nematus gallicola* Westw.

Larva.—May 24 it is only about 0.10 inch long; June 11 it is white, 0.10 to 0.13 inch long; July 24, 0.15 inch long; July 30, 0.15 to 0.20 inch long, pale greenish white, head pale brown. Legs freely movable. There was no earth in the jar in which the galls were placed, and most of the cocoons were spun in the galls and a few between them.—Walsh, Proc. Ent. Soc. Phila., VI, p. 255.

Six females and five males. Illinois. (Coll. Am. Ent. Soc.) Also two females (Cornell University), labeled as having been reared from gall of *Cecidomyia strobiloides.*

18. Pontania atra new species.

Female.—Length 4 mm.; slender, elongate; clypeus nearly truncate; ridges about anterior ocellus rounded or subobsolete; fovea very shallow, indistinct; antennæ slender, fourth joint distinctly longer than third; sheath slender, tapering, rounded at tip; claws with inner ray considerably shorter than outer, not very deeply notched; stigma narrow, elongate. Color shining black, including mouth parts, pronotum, and tegulæ. Trochanters, apical half of femora, tibiæ, and tarsi inclined to pallid, but strongly infuscated. Veins, including stigma, very dark brown.

One female. Michigan, April 21. G. C. Davis, collector. (Coll. U. S. Nat. Mus.)

19. Pontania hyalina Norton.

1864. *Messa hyalina* Norton. Proc. Ent. Soc. Phila., III, p. 8.
1867. *Messa hyalina* Norton. Trans. Am. Ent. Soc., I, p. 222. (Cat., etc., p. 84.)

Female.—Length 4 mm.; moderately robust, shining; clypeus very shallowly, if at all, excavated, almost truncate; vertex nearly smooth; ridges indistinct, rounded; antennal fovea very large and deep, nearly circular; antennæ somewhat longer than head and thorax, slender, scarcely tapering, third joint very much longer than fourth, third to fifth joints nodose at apex; sheath very elongate, narrow, tapering regularly to tip, more than half as long as abdomen; claws deeply cleft, rays subequal; outer veins of discal cells of hind wings and usually second recurrent and second transverse cubital interstitial; third cubital cell quadrate. Color black; tips of clypeus, labrum, mouth parts, extreme angles of pronotum, tegulæ, legs except extreme bases of coxæ, yellow; tips of posterior tibiæ, their tarsi, and the cerci dusky; upper and lower edges of femora sometimes infuscated; veins yellowish brown; basal half of stigma hyaline.

Gall.—(Frontispiece, fig 2.) Fleshy galls, occurring in two parallel rows, one on either side of the midrib, sometimes touching but not originating from the latter, and rarely extending to the edge of the leaf; sometimes as many as twenty on a single leaf; in other cases confined to a row on one side of the leaf, or occasionally occurring singly; shape irregular, elongate-ovate, projecting equally on both surfaces of the leaf; length 7 to 10 mm., the abortive ones smaller. Color on upper side more or less brownish red; beneath white, with slight purplish tinge. The galls result from the punctures of the females in the very tenderest leaves, the wound closing and becoming invisible. The eggs and larvæ are subject to the attacks of mites, Thrips, a curculionid (*Anthonomus sycophanta* Walsh), and a lepidopterous larva which eats out the entire interior of the gall, tenthredinid larva and all.

Many specimens. New Hampshire, New York, Massachusetts, Pennsylvania, New Jersey, and Canada. (Colls. Am. Ent. Soc. and U. S. Nat. Mus.)

Galls: Boseawen, N. H., C. V. Riley, collector, July 16–25, 1883, "on *Salix fragilis*, a large tree, 50 to 70 feet high, with a rough bark and trunk, smooth branches, and galls very plentiful on younger leaves all over the tree." The adults were obtained between April 29 and May 21, 1884; also chalcidid and other parasites.

Magnolia, Mass., July 19, 1883; gallmaker not reared. Hymenopterous parasites issued July 20, 1883.

Richfield Springs, N. Y., Theo. Pergande, collector, February 8, 1886; adults issued March 3 to April 21, 1887; also chalcidid parasites and a dipterous guest fly.

Pittsburg, Pa., J. C. Leach, collector, July 25, 1891.

Pointe au Pic, Quebec, Canada, E. Corning, collector, August 28, 1891.

20. **Pontania truncata** new species.

Female.—Length 4 mm.; moderately robust; clypeus almost squarely truncate, scarcely excavated; ridges about ocellar basin and frontal crest rounded, almost obsolete; antennal fovea large, circular; antennæ scarcely tapering, not longer than the head and thorax; claws not very deeply notched, inner ray considerably shorter than outer; sheath narrow, elongate, not acuminate, rounded at tip; venation normal. Color black, shining; clypeus, mouth parts, angles of pronotum, tegulæ, venter of abdomen, and legs, except bases of posterior coxæ, yellowish ferruginous; sheath brownish at apex and on margin; antennæ fulvous beneath, except on scape and first joint of flagellum.

One female. Southern California. (Coll. Am. Ent. Soc.)

21. **Pontania atriventris** new species.

Female.—Length 4.5 mm.; moderately robust; clypeus distinctly emarginate, lobes minute, pointed; frontal and lateral ridges of vertex rounded, subobsolete; antennæ with joints 3 to 5 subequal, fourth joint slightly longest; sheath narrow, elongate, tapering; claws deeply cleft; venation normal. Color black, shining, including orbits and venter of thorax and abdomen; legs beyond coxæ yellowish brown; femora darker, with upper and lower edges and the tips of posterior tibiæ and tarsi infuscated; clypeus and mouth parts pale; wings hyaline; veins brown; basal half of stigma hyaline.

Three females. Mount Hood, Oreg. (Coll. Am. Ent. Soc.)

22. **Pontania californica** new species.

Female.—Length 4.5 mm.; moderately robust; clypeus rather deeply and not broadly excavated, lobes rounded; head rather strongly punctured; ridges about ocellar basin not well defined; antennal fovea broad,

circular, shallow, breaking through rudimentary frontal crest; antennæ short, not as long as head and thorax, scarcely tapering; sheath very narrow, elongate, not acuminate, rounded at tip; inner ray of claw considerably shorter than outer; venation normal. Color black, shining; labrum, mouth parts, angles of pronotum, tegulæ, legs except bases of posterior coxæ, abdomen beneath, except sheath, yellowish ferruginous; sheath brownish rufous, smooth, shining; antennæ with flagellum inclined to rufous beneath; veins brown, stigma and costa paler basally; tarsi somewhat infuscated.

Male.—Length 4 mm.; structurally agrees with female; also colorational characters, except that the pronotum is entirely black, coxæ altogether black, and the venter of abdomen yellowish brown centrally, including hypopygium.

Gall.—Gall of the type *desmodioides*, not differing in the dried specimens in any noticeable manner from the latter. Length 8 to 12 mm. Normally but one gall occurs on a leaf. The galls were received from Mr. H. T. Turner, Eastlake, Cal., August 26, 1883, and the adults issued between September 18, 1883, and March 24, 1884.

Nine females and 3 males, 8 of which—6 females and 2 males—were reared from willow-leaf galls collected by Mr. Turner in California. (Coll. U. S. Nat. Mus.)

One male collected at Alameda, Cal., in March by Mr. Koebele, and the others collected in Southern California. (Colls. U. S. Nat. Mus. and Am. Ent. Soc.)

23. **Pontania gracilis** new species.

Female.—Length 5 mm.; slender, elongate species; abdomen centrally considerably broader than thorax; head very much narrower than thorax; clypeus distinctly, circularly emarginate; ridges of vertex rounded, subobsolete; frontal crest broken; antennæ with joints 3 to 6 subequal, fourth slightly longest; sheath elongate, narrow, tapering; claws deeply cleft; venation normal. Color in general black, shining; orbits, face beneath antennæ, pronotum, tegulæ, legs, and venter of abdomen reddish yellow; wings hyaline; veins, including all of stigma, dark brown.

Gall.—Galls somewhat similar to *desmodioides*, but much more robust, nearly spherical, extending from midrib to considerably beyond edge of leaf; diameter 9 to 13 mm.; surface smooth.

Galls collected in Virginia by Mr. Pergande September 29, 1885; adults issued April 19 and 29, 1886.

Two females. Virginia. (Coll. U. S. Nat. Mus.)

24. **Pontania stigmatalis** new species.

Female.—Length 4 mm.; robust; clypeus distinctly but rather broadly and circularly emarginate, lobes small, pointed; ridges of vertex sub-

obsolete; antennal fovea shallow, uniting more or less with the slight depression about anterior ocellus; antennæ very slender, rather elongate for the genus, joints 3 to 5 subequal; sheath long, narrow, regularly tapering to rather acute tip; venation normal; claws deeply cleft, rays subequal. Color black, shining; mouth parts, angles of pronotum, tegulæ, and legs, including tips of coxæ, whitish; upper and lower margins of femora are narrowly dark brown and the tips of the tibiæ and tarsi, particularly posterior pair, brownish; the posterior orbits are reddish yellow; wings hyaline; veins light brown, costa and stigma hyaline.

One female. Mount Hood, Oreg. (Coll. Am. Ent. Soc.)

25. **Pontania desmodioides** Walsh.

1866. *Nematus salicis desmodioides* Walsh. Proc. Ent. Soc. Phila., VI, p. 257.
1866. *Nematus inquilinus* Walsh. Proc. Ent. Soc. Phila., VI, p. 260.
1867. *Nematus salicis desmodioides* Norton. Trans. Am. Ent. Soc., I, p. 211. (Cat., etc., p. 73.)
1867. *Nematus inquilinus* Norton. Trans. Am. Ent. Soc., I, p. 213. (Cat., etc., p. 75.)
1878. *Nematus inquilinus* Provancher. Can. Nat., X, p. 57.
1883. *Nematus inquilinus* Provancher. Faun. Ent. Can. Hym., p. 190.
1895. *Pontania inquilina* Marlatt. Proc. Ent. Soc. Wash., III, p. 266.

Female.—Length 5 mm.; rather robust; head and thorax strongly punctured, somewhat opaque; clypeus deeply and narrowly emarginate, lobes rounded; ocellar basin well defined, side walls thick; frontal crest large, slightly notched; antennal fovea elongate, deeply excavated; claws rather deeply and evenly cleft; sheath narrow, long, regularly tapering, scarcely excavated beneath; cerci slender, tapering; wings with normal venation, except that the third cubital cell is nearly quadrangular. Color of antennæ, large spot including ocelli, stripe on anterior lobe of mesonotum, band in front of scutellum, most of metanotum, and abdomen dorsally except sides and apex dark brown, approaching black (mesonotum sometimes nearly altogether black, except scutel); occiput, balance of mesonotum, and the mesepimera reddish brown, inclined to resinous; face, orbits, pronotum, scutellum, abdomen beneath, and legs yellowish ferruginous; veins and stigma yellowish brown, the former scarcely lighter basally.

Male.—Length 4 mm.; structurally about as in female; vertex with numerous yellowish hairs; the ocellar basin less distinctly defined and the antennal fovea more triangular and deepening anteriorly; venation as in female, except that the intercostal vein is posterior to basal. Color brownish black; spot beneath antennæ, clypeus, mouth parts, lower and inner orbits, pronotum, tegulæ, legs for the most part, broad stripe on venter of abdomen and dorsal apex of same, yellowish; posterior tarsi infuscated; posterior orbits reddish yellow, fuscous; veins yellowish brown; stigma unicolorous.

Gall.—The gall is found on *S. humilis*. It is smooth, flattish, fleshy, sessile, yellowish green, monothalamous, semicircular in general shape like the seed of a Desmodium

or the quarter of an orange. It is about equally divided between the two surfaces of the leaf; no rosy cheek. Generally there is but one gall on a leaf; one leaf was seen with three upon it. Length 0.23 to 0.50 inch. One hundred and thirty-one specimens. Gall mature July 30.

Larva.—Three or four of these July 30, did not apparently differ from those of *s. pomum* examined the same day. When the larva quits feeding in the gall, there remains nothing of it but a shell as thin as paper. All the imagoes bred pupized inside the gall, but there was no earth within the breeding vase.—Walsh, Proc. Ent. Soc. Phila., VI, p. 257.

Two females, a bred specimen from Illinois (Walsh's type?) and a collected specimen from Massachusetts, and one male (Walsh's type?) apparently reared with the female described above. (Coll. Am. Ent. Soc.)

Nematus inquilinus Walsh is unquestionably identical with this species.

Galls probably belonging to this species have been received from the following localities: Lafayette, Ind., F. M. Webster, August 15, 1890, from which were obtained two parasites, *Sympiesis* sp. and *Eurytoma studiosa* Say, supposed to be parasitic on *Anthonomus sycophanta* Walsh; Richfield Springs, N. Y., Th. Pergande, collector, September 28, 1886. Cadet, Mo., J. G. Barlow, collector, September 24, 1890.

26. **Pontania sulphurea** new species.

Female.—Length 4 mm.; rather slender, glistening; head and thorax somewhat coarsely punctured; clypeus circularly emarginate, lobes triangular; ridges of vertex inclosing ocellar basin present, but not distinctly defined; frontal crest small; antennal fovea very shallow, almost wanting; antennæ scarcely as long as head and thorax, filiform, joints 3 and 4 subequal; sheath very narrow, elongate, tapering toward rounded tip; claws large, deeply notched; outer veins of discal cells of hind wings interstitial; cerci very short, tapering rapidly from base. Color sulphur yellow; antennæ, quadrate spot on vertex inclosing ocelli, large spot on each of anterior lobes of mesonotum, the post scutellum and two or three spots on the succeeding sclerite, band on basal plates, and on proximal segments of abdomen brownish black, lighter on abdomen; antennæ fulvous beneath, dusky toward tips; sheath edged with brown on the dorsal and apical margins; veins light yellowish brown; stigma and costa lighter basally.

Male.—Agrees in general characters with the female. The dorsum of thorax is black, and the basal segments of the abdomen are black centrally, forming a narrow dark stripe extending more than half way to the tip of the abdomen.

One female and one male. Montana and Nevada. (Coll. Am. Ent. Soc.)

27. **Pontania rugulosa** new species.

Male.—Length 4 mm.; rather slender; head roughened, coarsely punctured, thorax with finer puncturing; clypeus deeply, narrowly emarginate, lobes triangular; lateral walls of ocellar basin indistinct or

wanting; frontal crest sharply defined, prominent, slightly notched in the center; antennal fovea very minute, almost wanting, circular; antennæ longer than head and thorax, joints 3 and 4 subequal, joints 3 to 5 nodose at tips; procidentia projecting more than its width beyond terminal segment; hypopygium narrow, rounded at tip; claws deeply cleft; third cubital cell very short, quadrate; upper discal cell of hind wing not exceeding lower. Color black; clypeus, mouth parts, angles of pronotum, tegulæ, hypopygium, and legs, except bases of coxæ, yellowish ferruginous; tips of anterior tarsi faintly and tips of posterior tibiæ and their tarsi more strongly infuscated; antennæ fulvous beneath; veins dark brown; stigma unicolorous, brown; costa lighter at extreme base.

Two males, one reared (?) from willow gall. Michigan. (Coll. U. S. Nat. Mus.)

28. **Pontania placenta** Norton.

1867. *Nematus placentus* Norton. Trans. Am. Ent. Soc., I, p. 213. (Cat., etc., p. 75.)

Male.—Length 4.5 mm.; not very robust, shining; clypeus very broadly excavated, lobes small; vertex rounded, smooth, with a deep furrow beyond lateral ocelli; ridges limiting ocellar basin wanting or indistinct, as also frontal crest; antennal fovea large, very shallow, indistinctly limited; antennæ slender, not much longer than head and thorax; claws microscopically cleft at apex; procidentia not or scarcely projecting. The following veins are interstitial: Intercostal with basal, second recurrent with second transverse cubital and outer veins of discal cells of posterior wings. Color of antennæ, large spot on head about ocelli, occiput, mesonotum and metanotum, abdomen above except narrow lateral edge, more or less of metepisternum, and bases of posterior coxæ black; balance of body yellowish ferruginous.

One male. Canada. (Coll. Am. Ent. Soc.)

29. **Pontania pallifrons** Cresson.

1880. *Nematus pallifrons* Cresson. Trans. Am. Ent. Soc., VIII, p. 6.

Male.—Length 5 mm.; moderately robust; clypeus almost squarely truncate; mouth parts with short white hairs; vertex smooth, shining; ocellar basin distinctly defined; frontal crest rather large, unbroken; antennal fovea very small, circular, more deeply excavated at lower end; antennæ not much longer than head and thorax, robust and tapering; claws large, deeply divided, inner ray much shorter than outer; apex of abdomen not strongly recurved; procidentia short, strongly constricted at base, apical angles acuminate; cerci rather long, spindle shaped; venation normal, except that the intercostal vein is at right angles to costa; stigma very elongate, narrow. Color black, shining; face below ocellar basin, orbits, pronotum, tegulæ, all of venter, and legs yellowish ferruginous; metepisternum and extreme

bases of posterior coxæ brownish black; tips of posterior tibiæ and tarsi, and cerci, infuscated; antennæ unicolorous, brownish black.

One male. Cresson's type. Texas. (Coll. Am. Ent. Soc.)

30. **Pontania pyriformis** new species. (Frontispiece, fig. 5.)

Gall.—Galls occurring on leaves of *Salix californica*(?). Collected by Albert Koebele, Donner, Placer County, Cal., September 5, 1885. Galls occur on the underside of the leaf, attached to or near the midrib, usually singly, but sometimes two separately on the leaf, or more frequently partly coalescing, in which case one is usually abortive. They are pear-shaped, attached rather broadly ($\frac{1}{4}$ to $\frac{1}{2}$ greatest diameter) at the larger end, and rather acutely pointed, sometimes slightly [illegible]ed at tip, or more rarely bifurcate. They consist of a mere shell, containing with the larva very little frass, as though the larva had subsisted more on secretions than on the solid interior of the gall—the gall giving now no indication of ever having been fleshy and solid. The full-grown larva escapes through the base of the gall at its point of attachment, emerging, therefore, on the upper side of the leaf. The larva is white, with light-brown head and black eye-spots, 7 to 8 mm. long. Six specimens of *Pimpla cnuræ* Ashm.[1] were reared, but no gall-flies.

31. **Pontania monile** new species. (Frontispiece, fig. 6.)

Gall.—Gall occurring on the leaves of willow. Collected at the mouth of the American Fork Cañon, Utah, by Mr. E. A. Schwarz, June 29, 1891.

Smooth, globular, fleshy galls, 6 to 8 mm. in diameter, occurring from 2 to 6 together in a row on the underside of the midrib of willow leaf. The area of attachment is about one-half the greatest diameter of the gall, and on the upper side of the leaf appears as a slight convexity. When closely placed, the galls lose somewhat of the spherical shape, but rarely grow together. The larva begins eating out the interior of the gall near the base, and is rather robust, 10 mm. in length, with light, resinous head and dark eye-spots; light, yellowish-white body.

An exactly similar gall, except occurring 1 or 2 together, is represented in the collection, bearing the label January 10, 1884, without locality. It was collected in a later stage of development, and the interior is completely excavated. In most cases the larva had abandoned the gall, issuing near the base. The specimens probably came from the Northwest.

A gall similar to the last was also received from Mr. Lawrence Bruner, Robinson's Ranch, Wyoming, collected September 15, 1881, with the statement that it occurred on the leaves of *Populus angustifolia*. Examination of the leaves seems to indicate that they are willow rather than poplar, and the gall may be doubtfully referred to the type described above.

[1] Insect Life, III, p. 463.

VIII. Genus PTERONUS Jurine.

Jurine, Nouvelle Méthode de Classer les Hyménoptères et Diptères, T. I, p. 61.
Konow, Deutsche entomologische Zeitschrift, XXXIV, 1890, Heft II, p. 237.

Body large, hard; clypeus incised at tip; claws bifid; antennæ long, frequently pale beneath; stigma usually unicolorous; mesonotum and mesopleuræ usually not or sparsely punctured; head subrotund; labium not or slightly prominent; eighth dorsal abdominal segment of male subtriangular, produced at apex; procidentia truncate at apex; hypopygium narrow at apex and subtruncately rounded; sheath of female small, narrow; apex never acuminate.

The genus as characterized above by Konow is perhaps the largest in point of number of species of the several genera erected from the old genus *Nematus*. It is closely allied to the genus following it, but differs notably in the characters of the head and wings and in the general appearance. The males of the smaller species are not so readily separated from the males of *Pontania*. The genus has its type species in *Pteronus myosotidis* Fab., the only species remaining of those originally assigned to it by Jurine. The life-history of a few of the American species is familiar, as, for instance, that of *Pteronus ventralis* Say (the willow sawfly) and *P. ribesii* Scop. (the gooseberry sawfly). In habits, the other species are for the most part probably similar to these. Some confusion which has grown up with respect to some of the light-colored forms is referred to in the table for the separation of the species.

TABLE OF SPECIES.

Females.

A. Prevailing color black; pectus always black.
  Stigma narrow, usually straight on lower margin or strongly acuminate, elongate, more than three times as long as wide.
    Head, thorax, and abdomen black above.
      Stigma and femora brown or black.
        Abdomen beneath black ..... 1. *vicinalis* Cr.
        Abdomen pale beneath.
          Orbits black ..... 2. *occidentalis* n. sp.
          Orbits pale ..... 3. *latus* n. sp.
      Stigma and femora pale ..... 4. *pacificus* n. sp.
    Head and thorax black; abdomen more or less pale.
      Abdomen with broad lateral pale stripe ..... 5. *limbatus* Cr.
      Abdomen with broad, transverse yellow band ..... 6. *latifasciatus* Cr.
  Stigma broad, rounded on lower margin, not much more than twice as long as wide.
    Head and thorax black; venter of abdomen pale; dorsal arcs always more or less black, except sometimes terminal ones.
      Femora black ..... 7. *ventralis* Say.
      Hind femora only black ..... 8. *marlattii* Dyar.
      Femora pale; orbits black or strongly infuscated.
        Coxæ black; abdomen black above, except narrow apex of some of dorsal arcs ..... 9. *atriceps* n. sp.
        Coxæ pale; abdomen with narrow transverse brown stripes on dorsal arcs, sometimes limited to basal segments, mostly pale; sheath pale ..... 10. *coloradensis* n. sp.

Coxæ pale; abdomen with broad central black stripe and with apex beneath strongly infuscated; sheath black.
Second recurrent interstitial with first cubital.
11. *harringtoni* n. sp.
Second recurrent received well within second cubital cell.
12. *fylesi* n. sp.
Femora pale; orbits pale or reddish.
Sheath broad, rounded or truncate at apex; stigma brown.
13. *kincaidi* n. sp.
Sheath narrow, tapering; stigma yellow ..... 14. *forcatus* n. sp.
Sheath narrow, tapering; stigma bicolorous; mesepimera with pectoral black spot ..... 15. *bicolor* n. sp.
Head and thorax black; abdomen pale, except sometimes basal dorsal arc and, rarely, terminal arcs.
Hind femora black, at least apically.
Hind tibiæ with brown gradually increasing in intensity from base to tip; orbits and mouth parts pale..... 16. *tricolor* n. sp.
Hind tibiæ with basal one-third or one-half white; head black.
Elongate; basal arc black.
Terminal segments black; legs pallid and black.
17. *rufocinctus* Harrington.
Terminal segments yellow; legs reddish yellow and black.
18. *erythrogaster* Norton.
Short ovate; basal arc indistinctly or not at all infuscated.
Three terminal arcs pale..... 19. *corylus* Cr.
Three terminal arcs black ..... 20. *dyari* n. sp.
Hind femora pale.
Veins and stigma dark brown.
Angles of pronotum and the coxæ black.. 21. *fulvicrus* Prov.
Angles, etc., pale.
Lateral lobes mesonotum mostly black; basal segment of abdomen infuscated..... 22. *populi* n. sp.
Lateral lobes mesonotum reddish; basal segment pale.
23. *hudsonii* Dyar.
Veins and stigma yellowish.
Orbits and spot below bases of antennæ pale.
24. *auratus* n. sp.
Orbits and spot below bases of antennæ black.
25. *californicus* n. sp.
Head and thorax more or less pale above.
Antennæ yellow or ferruginous.
Hind femora mostly black..... 26. *antennatus* n. sp.
Hind femora pale..... 27. *ribesii* Scop.
Antennæ black; legs pale..... 28. *edwardsii* Cr.

AA. Prevailing color of dorsum black; pectus and venter pale (except dusky spot on pectus of *hyalinus* and minute one in case of *rufus*, and sometimes venter of abdomen black in *militaris*).
Head altogether black.
Thorax with lateral lobes reddish; abdomen black dorsally..... 29. *militaris* Cr.
Thorax and abdomen reddish, except mesoscutellum, metanotum and basal central area of abdomen ..... 30. *thoracicus* Harr.
Head black; mouth parts and orbits pale.
Stigma and costa brown.
Scutellum black.
Head nearly spherical, viewed latterly; clypeus narrowly and deeply excavated, short, robust..... 31. *odoratus* Dyar.

Head normal, triangular; clypeus rather broadly excavated, elongate ..... 32. *cornelli* n. sp.
Scutellum pale.
Posterior tibiæ and tarsi dark brown ..... 33. *trilineatus* Nort.
Legs altogether resinous ..... 34. *magus* n. sp.
Stigma and costa pale.
Scutellum entirely or for most part black.
Costa enlarged at apex; small, robust species .. 35. *quercus* n. sp.
Costa normal; elongate species.
Lobes of mesonotum altogether black ..... 36. *hyalinus* n. sp.
Lobes with light sutures ..... 37. *vertebratus* Say.
Scutellum pale ..... 38. *integer* Say.

AAA. Dorsum pale or with few black spots.[1]
Stigma pale.
Crest strongly bituberculate.
Claws normal ..... 39. *mendicus* Walsh.
Claws minutely cleft ..... 40. *vancouverensis* n. sp.
Crest unbroken, straight ..... 41. *koebelei* n. sp.
Crest unbroken, curved anteriorly; stigma narrow, straight on lower margin ..... 42. *pinguidorsum* Dyar.
Stigma brown; body without dark markings ..... 43. *unicolor* n. sp

Males.

Procidentia very broad and large.[2]
Elongate, slender; orbits black ..... 44. *longicornis* n. sp.
Short, robust; orbits reddish ..... 27. *ribesii* Scop.
Procidentia narrow; sometimes subobsolete.
Black; pectus always black.
Body altogether black, except sometimes mouth parts, pronotum, and tegulæ.
Legs, particularly femora and posterior tibiæ, strongly infuscated.
Ridges about ocellar basin prominent ..... 45. *iridescens* Cr.
Ridges about ocellar basin obsolete ..... 46. *decoratus* Prov.
Legs pale, except tips posterior tibiæ and their tarsi.
Clypeus distinctly emarginate; procidentia minute.
Stigma short, robust; apical half hind tibiæ infuscated.
47. *lombardæ* n. sp.
Stigma rather elongate, acuminate; extreme tips of hind tibiæ sharply brown.

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[1] Three species of the luteus group described by Norton are distinguishable by the color characteristics. The types are lost, with the possible exception of *trivittatus*. *Stigmatus* may prove to be a good species. *Mendicus* and *trivittatus* are closely allied, and probably identical, the older name, *mendicus*, holding. *Monochroma* may prove to be a light form of *mendicus*. These species all fall in the table with *mendicus*, with which they are closely allied. *Stigmatus* and *monochroma* may be good species, and the original descriptions of them are appended (Nos. 47 and 48). The following synopsis indicates the color differences of this group:

Dorsum pale, except tip of scutellum, metanotum, and stripe down tergum ♀ 49. *stigmatus* Nort.
Dorsum with a black spot about ocelli and three on lobes of mesonotum; body otherwise pale ..... ♀ 39. *trivittatus* Nort.
Dorsum with two spots on mesonotum, tip of scutellum, and spots on metanotum black ..... ♀ 39. *mendicus* Walsh.
Insect altogether pale, including antennæ ..... ♀ 50. *monochroma* Nort.

[2] In this character the two following species depart in this sex from the characterization of the genus.

Venter black; second recurrent interstitial.
11. *harringtoni* n. sp.
Venter pale; second recurrent not interstitial.
12. *fylesi* n. sp.
Clypeus nearly truncate; procidentia long and projecting, keeled.
20. *dyari* n. sp.
Legs pale, pygidium pale ..... 48. *dubius* n. sp.
Body black, except venter of abdomen, femora, and sometimes terminal dorsal arcs.
Abdomen entirely black dorsally.
Orbits pale; mesepimera black ..... 13. *kincaidi* n. sp.
Orbits black; upper half of mesepimera pale .... 30. *thoracicus* Harr.
Abdomen with more or less of dorsal segments laterally and apically pale.
Procidentia minute, usually slightly emarginate at tip; abdomen usually nearly interrupted with yellow centrally. 7. *ventralis* Say.
Procidentia medium, rounded at tip; abdomen not as above.
10. *coloradensis* n. sp.
Black above for most part; pectus and venter pale.
Stigma and costa brown.
Dorsum, including scutellum, black.
Head nearly spherical, viewed laterally; clypeus narrowly and deeply excavated; short, robust ..... 31. *odoratus* Dyar.
Head normal, triangular; clypeus rather broadly excavated; elongate ..... 32. *cornelli* n. sp.
Dorsum black, scutellum pale ..... 41. *vancouverensis* n. sp.
Stigma and costa pale.
Procidentia as long as wide ..... 39. *mendicus* Walsh.
Procidentia twice as long as wide ..... 37. *vertebratus* Say.

INDEX TO SPECIES OF PTERONUS.

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atriceps n. sp. ♀ 9
auratus n. sp. ♀ 24
bicolor n. sp. ♀ 15
californicus n. sp. ♀ 25
coloradensis n. sp. ♂ ♀ 10
cornelli n. sp. ♂ ♀ 32
corylus Cresson ♀ 19
decoratus Provancher ♂ 46
dorsivittatus Cr. = vertebratus.
dubius n. sp. ♂ 48
dyari n. sp. ♂ ♀ 20
edwardsii Cresson ♀ 28
erythrogaster Norton ♀ 18
foveatus n. sp. ♀ 14
fulvicrus Provancher ♀ 20
fylesi n. sp. ♂ ♀ 12
harringtoni n. sp. ♂ ♀ 11
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salicis Ashm. = fulvicrus.
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trilineatus Norton ♀ 33
trivittatus Norton = mendicus.
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vancouverensis n. sp. ♂ ♀ 40
ventralis Say ♂ ♀ 7
vertebratus Say ♂ ♀ 37
vicinalis Cresson ♀ 1

1. Pteronus vicinalis Cresson.[1]

1880. *Nematus vicinalis* Cresson. Trans. Am. Ent. Soc., VIII, p. 4.

Female.—Length 8.5 mm.; very large, robust, shining, obscured by some rather dense punctuation on head and thorax; clypeus rather deeply, circularly emarginate; ridges about ocellar basin flattened, indistinct; frontal crest broad, slightly notched; antennal fovea shallow, indistinct; antennæ not much longer than head and thorax, scarcely tapering, joints 3 to 5 subequal; intercostal very slightly, if at all, inclined; stigma narrow, acuminate; sheath broad, tapering, obtusely pointed; cerci slender, not tapering; claws large, deeply notched, rays equal. Color black; clypeus, apices of coxæ, trochanters and tibiæ except apices of posterior pair, and anterior tarsi whitish, infuscated; posterior tarsi, with tips of posterior tibiæ, nearly black; veins very dark brown, including stigma and costa, the latter to base; tegulæ dark brown, strongly infuscated; wings somewhat infuscated.

One female, Cresson's type. California. (Coll. Am. Ent. Soc.)

2. Pteronus occidentalis new species.

Female.—Length 7.5 mm.; moderately robust, shining; clypeus broadly and shallowly emarginate, approaching truncate; antennal fovea broad, circular; antennæ distinctly tapering, not much longer than head and thorax, third joint distinctly longer than fourth; upper middle cell of hind wings as long as or more commonly longer than lower; intercostal vein very close to basal vein; third cubital cell long, sides almost parallel; stigma long, narrow; sheath rather sharply pointed; claws evenly and rather finely cleft. Color black; triangular space below antennæ, tip of clypeus and the mouth parts, pronotum, tegulæ, legs except middle portion of femora and tips of hind tibiæ, and more or less of all tarsi whitish; tarsi and tips of hind tibiæ strongly infuscated, brownish; venter of abdomen, except tip, pale; veins, including stigma and costa, dark brown; wings nearly hyaline.

Nine females, three bred from willow larvæ collected in Placer County, Cal., and the others collected about Los Angeles. (Coll. U. S. Nat. Mus.)

3. Pteronus latus new species.

Female.—Length 8 mm.; very robust and broad, viewed from above; abdomen scarcely constricted at base, sides nearly parallel; clypeus very broadly and shallowly emarginate; antennal fovea triangular, distinctly excavated; ocellar basin well defined; frontal crest slightly notched at center; antennæ moderately robust, tapering, joints 3 and 4 subequal; venation normal; stigma rather narrow, tapering gradually to apex; sheath broadly rounded on lower margin, pointed at tip;

[1]This, with the following five species, is allied to the genus *Amauronematus* in the character of the stigma, but seem to be thrown out of the latter genus by lacking any unusual development of labium and other mouth parts, as well as other characters of the genus.

claws evenly but not very coarsely notched. Color black; area about bases of antennæ, orbits, and mouth parts, pronotum, tegulæ, legs for the most part, and venter of abdomen pale; femora, tips of hind tibiæ and their tarsi, brown; veins and stigma brown, wings hyaline, slightly brownish beneath stigma.

Two females. Massachusetts and Pennsylvania. (Coll. Am. Ent. Soc.)

4. **Pteronus pacificus** new species.

Female.—Length 6.5 mm.; robust, shining; clypeus broadly but distinctly emarginate; walls of ocellar basin distinctly defined; frontal crest unbroken; fovea deep, oval; antennæ short, slender, scarcely tapering, joints 3 to 5 subequal; venation normal, except that the third cubital cell is only about half as wide at base as at apex; stigma narrow, regularly rounded on lower margin, acuminate; sheath broad, tapering to obtuse tip; claws not very deeply notched. Color black; clypeus, mouth parts, extreme angles of pronotum, tegulæ, terminal dorsal segment, more or less of venter of abdomen, together with legs except bases of coxæ, dull resinous; posterior orbits reddish; wings hyaline; stigma light yellow; veins otherwise light brown.

Four females. Olympia, Wash. Trevor Kincaid, collector. (Coll. Cornell Univ.)

5. **Pteronus limbatus** Cresson.

1880. *Nematus limbatus* Cresson. Trans. Am. Ent. Soc., VIII, p. 8.

Female.—Length 7 mm.; rather short and robust, finely punctured, but shining; clypeus very slightly and broadly notched; frontal crest very prominent, broadly curved, unbroken; sides of ocellar basin strongly and sharply raised; antennal fovea small, indistinct; antennæ short, not much longer than head and thorax, tapering, third and fourth joints subequal; intercostal vein a little anterior to basal, not, or but slightly, inclined, second recurrent interstitial with second transverse cubital (in one specimen latter vein is wanting), and outer veins of middle cells of hind wings also interstitial; second and third transverse cubitals of nearly equal length; stigma elongate, narrow, terminating rather abruptly; sheath short, broad, obtusely pointed; cerci short, robust, scarcely tapering; claws deeply notched, rays about equal. Color of head, thorax, broad stripe along dorsal center of abdomen, sheath, cerci, and extreme tips of posterior tibiæ and their tarsi brownish black; upper orbits and sides of mesonotum tinged with reddish; clypeus and mouth parts, most of pronotum, tegulæ, lateral third of dorsum of abdomen, all of venter of abdomen, and legs yellowish ferruginous; tips of anterior tarsi slightly infuscated; veins, including costa nearly to base, and stigma brown.

Two females, Cresson's types. Illinois. (Coll. Am. Ent. Soc.)

6. Pteronus latifasciatus Cresson.

1880. *Nematus latifasciatus* Cresson. Trans. Am. Ent. Soc., VIII, p. 7.
1886. *Nematus latifasciatus* Provancher. Add. Faun. Can. Hym., p. 24.
1895. *Nematus latifasciatus* Dyar. Trans. Am. Ent. Soc., XXII, p. 304.

Female.—Length 8 mm.; somewhat elongate, shining; clypeus shallowly and broadly emarginate, lobes short, broad; frontal crest and sides of pentagonal area strongly raised; antennal fovea large, oval, deeply excavated; antennæ unusually slender and long, almost equaling thorax and abdomen in length, third and fourth joints subequal; intercostal oblique and almost its own length anterior to basal vein; upper cell of hind wings extending nearly one-fourth its length beyond lower; stigma narrow, elongate; sheath moderately robust, obtusely pointed, with straight upper margin; cerci very slender and nearly as long as second transverse cubital vein; claws very deeply notched, rays almost equal. Color of head, thorax with basal plates, four terminal segments of abdomen dorsally and sheath, tips of hind femora, apical half of hind tibiæ, hind tarsi, and extreme bases of hind coxæ brownish black; tips of anterior tarsi dusky; tips of clypeus, labrum, bases of mandibles, palpi, and basal half of hind tibiæ whitish; upper margin of pronotum, tegulæ, first four segments of abdomen dorsally except apex of fourth, all of venter, and legs yellowish ferruginous; wing veins, including costa, brown.

One female, Cresson's type. New Hampshire. (Coll. Am. Ent. Soc.)

Mr. H. G. Dyar has characterized the larva (l. c.) from specimens found on birch.

7. Pteronus ventralis Say.

1824. *Nematus ventralis* Say. Keating's Narr. Exp., II, App., p. 315.
1859. *Nematus ventralis* LeConte. Say, Ent., II, p. 211.
1861. *Nematus ventralis* Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 159.
1867. *Nematus ventralis* Norton. Trans. Am. Ent. Soc., I, p. 201. (Cat., etc., p. 63.)
1869. *Nematus ventralis* Scudder. Ent. Corr. Harr., p. 270.
1870. *Nematus ventralis* Riley. Am. Ent. and Bot., II, p. 276.
1873. *Nematus ventralis* Sylvester. Rept. U. S. Dept. Agric., p. 254.
1881. *Nematus ventralis* Thomas. 10th Rep. Ent. Ill., 1880, p. 68.
1885. *Nematus ventralis* Forbes. 14th Rep. Ent. Ill., 1884, p. 117.
1888. *Nematus ventralis* Howard. Insect Life, I, p. 33, fig. 5.
1889. *Nematus ventralis* Lugger. Bull. 9, Minn. Exper. Sta., p. 51.
1889. *Nematus ventralis* Orcutt. Bull. 13, Dakota Exper. Sta., p. 13.
1889. *Nematus ventralis* Bruner. Bull. 14, Nebr. Exper. Sta., p. 78.
1890. *Nematus ventralis* Packard. Rep. U. S. Ent. Comm., V, pp. 524, 588.
1891. *Nematus ventralis* Orcutt. Bull. 22, S. Dak. Exper. Sta. (March).
1895. *Nematus ventralis* Dyar. Trans. Am. Ent. Soc., XXII, p. 304.

Female.—Length 8 mm.; only moderately robust; abdomen broadest beyond middle, shining; clypeus broadly and shallowly emarginate, lobes rounded; frontal crest large, indistinctly broken; ocellar basin well defined; antennal fovea deep, elongate, triangular; antennæ slender, distinctly tapering, smooth, third joint usually slightly exceeding

fourth; upper middle cell of hind wings short, quadrate, terminating at or usually within apex of lower cell; intercostal vein very slightly inclined, interstitial, or nearly so, with basal; second recurrent interstitial, or nearly so, with second transverse cubital vein; third cubital cell not strongly divaricating apically; stigma broad, rounded beneath, widest at center; sheath pointed, slightly excavated above and rounded beneath; moderately robust; cerci robust, obtusely pointed; claws large, deeply cleft, rays subequal. Color brownish black, including dorsum generally, coxæ, femora except tips, tips of hind tibiæ, all of hind tarsi, sheath, cerci, and more or less of apex of abdomen beneath; balance yellowish white, viz, inner and outer orbits, face below base of antennæ, pronotum except two or three dusky spots (sometimes wanting), tegulæ, lateral edges of thorax and abdomen, and venter; palpi, more or less of extreme tips of fore tibiæ, and commonly some of fore tarsi dusky; wings very faintly smoky; veins, including stigma, brown, costa pale on basal half.

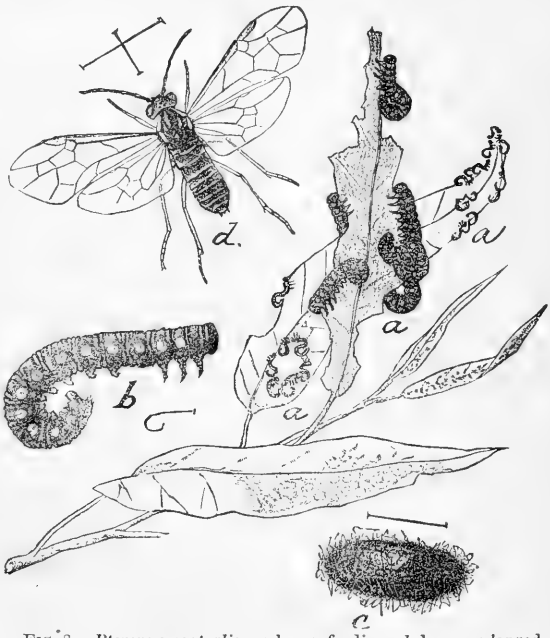

FIG. 8.—*Pteronus ventralis*: *a*, larvæ feeding; *b*, larva, enlarged; *c*, cocoon, and *d*, adult—both enlarged (from Insect Life).

Male.—Length 7 mm.; rather elongate; structurally as in female; procidentia as long as broad, narrow, tapering, squarely truncate or slightly emarginate at apex, constricted at base; hypopygium emarginate as viewed from end; antennæ compressed laterally, stouter than in female. Color as in female, except that the inner orbits are black and the legs are dark reddish yellow, except bases of coxæ and posterior tarsi; abdomen reddish yellow beneath and dorsally over segments 2 and 3 and less on following ones; bases of all dorsal segments dark, terminal ones particularly so; hind tibiæ very slightly infuscated, particularly at tips.

Many bred specimens of both sexes. Washington, D. C. (Coll. U. S. Nat. Mus.)

A male and a female from Carbondale, Ill. (Coll. Am. Ent. Soc.), differ from the above in that the female has the upper middle cell of the hind wings exceeding the lower, and in the male the same terminates at apex of lower. Three males from Michigan (Coll. U. S. Nat.

Mus.) vary from above in having an elongate upper middle cell in hind wings, which, however, does not exceed lower, and in that the intercostal is a little anterior to basal.

Food-plants: *Populus* and *Salix*.

8. **Pteronus marlattii** Dyar.

1894. *Nematus marlattii* Dyar. Trans. Am. Ent. Soc., XXII, p. 305.

Female.—Length 5.5 mm.; moderately robust, shining; clypeus broadly and shallowly notched; ocellar basin deep and with well-defined walls; frontal crest unbroken; antennal fovea large, triangular, deeply excavated; antennæ slender, third and fourth joints subequal; venation normal; stigma broad, ovate, widest at center, rounded on lower margin; sheath broad, obtusely pointed, upper margin slightly emarginate; claws deeply cleft, rays subequal. Color of head, thorax, epimera and dorsum of abdomen for the most part, and outer half of posterior femora black; apices of posterior tibiæ and their tarsi dusky; face below antennæ, mouth parts, orbits, angles of pronotum narrowly, tegulæ, narrow apical margin of dorsal segments and last two segments, venter except epimera and some dusky spots on lateral margin of abdomen, and legs except as noted pallid, inclined to yellowish; apex of sheath brownish; antennæ ferruginous beneath and toward apex; veins, including stigma and costa, the latter nearly to base, brown.

Characterized in manuscript by me from a specimen collected in New Hampshire (Coll. Am. Ent. Soc.); first published by Dyar from a specimen bred from larva on alder (Dyar's Coll.).

9. **Pteronus atriceps** new species.

Female.—Length 6.5 mm.; moderately robust; clypeus very broadly and shallowly emarginate, lobes minute; frontal crest strongly developed, entire; lateral walls of ocellar basin not strongly raised; fovea elongate, deep; antennæ medium, with joints 3 and 4 subequal; third cubital cell not more than one-third as wide at base as at apex, about four times as long as wide at base; venation otherwise normal; stigma broad, rounded on lower margin, tapering gradually from near base to tip; sheath broad basally, tapering to an obtuse tip, upper margin straight; claws not very deeply notched, inner ray nearly as long as outer. Color black, shining; tips of clypeus, mouth parts, tegulæ, legs except coxæ, and venter of abdomen, including lateral edges of dorsal sclerites, yellow; upper posterior orbits and outer angles of pronotum reddish; legs slightly infuscated, particularly the tarsi; sheath dark brown; veins brown, stigma unicolorous, brown.

One female. Nevada. (Coll. Am. Ent. Soc.)

10. **Pteronus coloradensis** new species.

Female.—Length 6 mm.; rather elongate, surface shining; clypeus deeply, circularly emarginate, lobes rounded; frontal crest and sides of

pentagonal area distinctly raised, former unbroken; antennal fovea deep, triangular; antennæ slender, longer than head and thorax, third and fourth joints equal; intercostal vein its own length anterior to basal vein; upper cell of hind wings exceeding lower; stigma broad, rounded on lower margin; second transverse cubital one-third length of third, or third cubital cell strongly divaricating; sheath very narrow and obtusely pointed at tip, smooth, without or with very minute hairs; cerci short; claws deeply and almost evenly notched. Color of head except faint ferruginous touches about orbits, thorax, the first dorsal sclerite of abdomen, and bases of posterior coxæ black; following dorsal sclerites of abdomen with interrupted brown stripes on each; antennæ brownish, lighter beneath, especially toward tips; extreme tips posterior femora, apical two-thirds of their tibiæ and all their tarsi, tips of anterior pairs of tarsi, and narrow margin of sheath fuscous; clypeus and mouth parts light resinous; legs and abdomen, except as noted, light ferruginous; wing veins light brown, stigma and costa paler basally.

Male.—Length 6 mm.; slender, elongate; clypeus broadly emarginate, lobes short, pointed; walls about ocellar basin very minute, but distinctly defined; crest unbroken, not strongly raised; fovea very shallow, triangular; antennæ robust, strongly tapering, somewhat flattened, joints 3 to 5 subequal, third a little longer than others; venation normal; procidentia narrow, projecting somewhat more than its width, rounded at tip; claws rather deeply cleft, rays subequal. Color black, shining; mouth parts and legs, venter of abdomen, including more or less of apical edge of dorsal segments and nearly all of terminal segments, yellowish ferruginous; angles of pronotum widely, and tegulæ pallid; wings hyaline, veins brown, including stigma and costa; hind tibiæ and their tarsi brownish; posterior orbits very faintly reddish, strongly infuscated; antennæ reddish, especially beyond basal joints and on lower edge.

Three females and two males. Colorado and Montana. (Coll. Am. Ent. Soc.)

11. **Pteronus harringtoni** new species.

Female.—Length 7 mm.; robust, shining; clypeus broadly and not deeply notched; ocellar basin distinctly defined; crest strong, unbroken; fovea deep, with lateral channels running from it over bases of antennæ; antennæ short, tapering, joints 3 and 4 nearly equal; intercostal at right angles, or nearly so, with costa; second recurrent interstitial, stigma rounded on lower margin, somewhat acuminate at apex; cerci very short; claws deeply cleft, rays equal. Color black; angles of pronotum, tegulæ, legs for the most part, and venter of abdomen, together with marginal third of dorsum, reddish yellow; tip of clypeus and mouth parts yellowish, infuscated; extreme tips of posterior tibiæ

and posterior tarsi brownish black; wings with dusky band extending transversely below the stigma; stigma and veins dark brown.

Male.—Length 6 mm.; rather slender; characters of head and antennæ as in female; procidentia short, narrow, slightly constricted basally, truncate at apex; venation as in female. Color black; border of pronotum and tegulæ yellowish; legs as in female; basal half of venter of abdomen beneath reddish, strongly infuscated; dusky band on wings somewhat lighter than in female.

One female and one male received from Mr. Harrington, who reports that this species has been somewhat abundant on willows on the experimental farm at Ottawa, Canada. He was at first of the opinion that it might prove to have been introduced from Europe, but it seems to be distinct from any European species and also to be new to our fauna. I take pleasure, therefore, in dedicating it to Mr. Harrington. A male specimen has since been submitted to me for identification by Rev. Thomas W. Fyles, of South Quebec, Canada. (Coll. U. S. Nat. Mus.)

12. **Pteronus fylesi** new species.

1891. *Nematus pallidiventris* Fallen. Fyles, Can. Ent., XXIII, p. 135.

Female.—Length 7 mm.; robust, shining; clypeus circularly emarginate, lobes rounded; walls about ocellar basin well developed; frontal crest unbroken; fovea oval; antennæ slender, tapering, longer than head and thorax, third and fourth joints nearly equal; venation normal; stigma broad, regularly tapering toward apex; sheath broad, tapering, slightly produced, and with a rather dense tuft of short hairs at extreme tip; cerci short; claws deeply and evenly cleft. Color black; triangle beneath bases of antennæ, clypeus for the most part, labrum and other mouth parts, pronotum, tegulæ, abdomen except broad dorsal stripe, and legs for the most part reddish yellow; sheath, cerci, extreme tips of posterior tibiæ, and the posterior tarsi dark brown; anterior tarsi slightly infuscated; extreme bases of coxæ brown.

Male.—Length 6 mm.; slender; structural characters in general as in female; antennæ somewhat stouter, slightly compressed; procidentia short, narrow, truncate at apex. Color as in female, except that the dorsum of abdomen is entirely black and the venter is slightly infuscated, especially toward apex.

Two females and one male received from Rev. Thomas W. Fyles, of South Quebec, Canada. The species was described by Mr. Fyles in the Canadian Entomologist, as noted above, the identification having been made for him by the Abbé Provancher. I have compared the species with specimens of *pallidiventris* Fallen, and there is a merely superficial color resemblance; *pallidiventris* belongs to the genus *Pristiphora*, and is a totally distinct insect. This species seems to be distinct from any European species, and while allied somewhat closely

to *limbatus* Cresson and *harringtoni* n. sp., yet differs sufficiently, particularly in the male sex, to warrant the creation of a new species. It is possible that this is an introduced species, but if so it seems not to have been described abroad. It was found abundantly on Russian willow introduced into Canada by the late Charles Gibbs.

13. **Pteronus kincaidi** new species.

Female.—Length 6.5 mm.; rather robust; abdomen broad, scarcely tapering until near tip; clypeus distinctly emarginate, lobes broad and rounded; walls about ocellar basin nearly obsolete; frontal crest strongly developed, slightly broken by backward extension of elongate antennal fovea; antennæ short, scarcely tapering, joint 4 a little longer than 3; venation normal; stigma broad, rounded on lower margin; claws deeply and evenly cleft; sheath very broad, robust, scarcely tapering, rounded at apex; cerci short, tapering. Color black; space between antennæ and face beneath including narrow orbits, pronotum, tegulæ, venter of abdomen extending over onto the sides of dorsum, especially on the posterior margin of the segments, and the legs rather dark resin yellow; extreme bases of coxæ and the hind tarsi particularly, with extreme tips of hind tibiæ infuscated; sheath dark brown; wings hyaline; veins, including costa and stigma, dark brown.

Male.—Males agree with the females in general characteristics; procidentia short, narrow, and rounded apically, rather broad basally; hind tibiæ rather strongly infuscated, especially toward tip; dorsal arcs of abdomen entirely black; antennæ more elongate and somewhat more robust.

Nine females and five males collected in April and May by Trevor Kincaid, Olympia, Wash. (Coll. Cornell Univ.)

14. **Pteronus foveatus** new species.

Female.—Length 5.5 mm.; moderately robust, shining; clypeus broadly emarginate, lobes sharp pointed; ridges about ocellar basin strongly and sharply defined; frontal crest unbroken; antennal fovea large, circular, deeply and sharply excavated; antennæ a little longer than head and thorax, scarcely tapering, joints slender, 3 and 4 subequal; sheath narrow, tapering, upper edge straight, tip rounded, hairs minute; claws not very deeply cleft, rays equal; venation about normal; third cubital cell more than twice as wide at apex as at base; stigma narrow, elongate, subacuminate. Color of antennæ, large spot extending back from occiput including ocelli with branches running down in front of eyes, base of the head, thorax, bases of first six dorsal segments of abdomen except on outer edges, and the epimera except anterior upper angles of the mesepimera black; antennæ slightly rufous toward tip; sheath brownish; body otherwise yellowish ferruginous, including spot below antennæ, mouth parts, angles of pronotum, tegulæ, lateral edges and

posterior margin of dorsal segments, two terminal segments, venter, and legs; veins dark brown, including costa nearly to base; stigma yellowish, unicolorous, border brownish.

One female. Washington. (Coll. Am. Ent. Soc.)

15. **Pteronus bicolor** new species.

Female.—Length 5.5 to 6 mm.; robust; clypeus broadly emarginate, lobes small, pointed; ocellar basin with rather faint lateral walls; frontal crest unbroken; antennal fovea broad, shallow; antennæ slender, scarcely tapering, joints 3 and 4 subequal; venation normal; stigma broad, rounded on lower margin, rather abruptly narrowed toward tip; sheath tapering to obtusely pointed tip, straight on upper side; claws evenly but not deeply divided. Color black above, pale beneath, the black limited to dorsal area of antennæ and all of the two basal joints, large spot including ocellar basin, ocelli, the occiput, thorax and abdomen above, spot on upper half of mesepimera and large spot on pectus, together with tip of sheath; face white; orbits and venter pallid, including also lateral edges of terminal abdominal segments above and all of last segment; wings hyaline; veins brown; stigma pale basally.

Two females, Mount Hood, Oreg. (Coll. Am. Ent. Soc.), and Olympia, Wash. (Coll. Cornell Univ.).

16. **Pteronus tricolor** new species.

Female.—Length 7 mm.; moderately robust, shining; clypeus broadly and shallowly emarginate, lobes triangular; frontal crest and sides of pentagonal area sharply defined, former unbroken; antennal fovea circular; intercostal vein more than its own length anterior to basal vein; third cubital cell not much more than one-half as wide at base as at apex; stigma moderately broad, rounded on lower margin; upper middle cell of hind wings exceeding lower; sheath smooth, polished, pointed, bordering hairs very minute. Color of head and thorax for most part, first dorsal segment of abdomen and lighter bands on two following segments (nearly wanting on third), apex of sheath, apical three-fourths of hind femora, hind tibiæ and tarsi (the former gradually paling toward bases), brownish black; the orbits and portions of the center of thorax, including scutellum, light yellowish brown; balance of abdomen ferruginous; clypeus and mouth parts, outer angles of pronotum, tegulæ, anterior legs and posterior pair, except as noted, yellowish white; anterior femora and tarsi very slightly tinged with reddish; stigma and veins, including costa, except extreme base of latter, brown.

One female. New Hampshire. (Coll. Am. Ent. Soc.)

17. **Pteronus rufocinctus** Harrington.

1893. *Nematus rufocinctus* Harrington. Can. Ent., xxv, p. 58.

Female.—Length 8 mm.; rather elongate, shining; clypeus very shallowly emarginate, approaching truncate; ocellar basin with very sharply

defined and strongly raised walls; frontal crest prominent, sharp, unbroken; fovea distinctly defined, oval; second, third, and fourth joints of antennæ subequal; venation normal, except that the third cubital cell is quadrate; sheath short, obtusely pointed, quite densely clothed with hairs; cerci slender, slightly tapering; claws deeply cleft, rays subequal. Color black; center of basal segment of abdomen above and all of three following segments and more or less of the base of the succeeding segment reddish yellow; tip of clypeus and mouth parts, anterior legs for the most part, coxæ except bases, trochanters, bases of femora, and basal half of tibiæ of hind legs pallid; angles of pronotum and the tegulæ pallid, infuscated; femora of fore and middle legs rather strongly infuscated; stigma and veins dark brown; wings nearly hyaline; spot in second cubital cell prominent.

Redescribed from Harrington's type specimen. (Coll. Harrington.)

18. Pteronus erythrogaster Norton.

1864. *Nematus erythrogaster* Norton. Proc. Ent. Soc. Phila., III, p. 8.
1867. *Nematus erythrogaster* Norton. Trans. Am. Ent. Soc., I, p. 205. (Cat., etc., p. 67.)
1886. *Nematus erythrogaster* Provancher. Add. faun. Can. Hym., p. 23.

Female.—Length 7.5 mm.; moderately robust, shining; head and thorax finely punctured; clypeus shallowly and broadly emarginate, lobes triangular, rather pointed; frontal crest and sides of pentagonal area strongly raised, former unbroken; antennal fovea circular, deeply excavated; antennæ moderate, somewhat longer than head and thorax; intercostal very near basal vein; second cubital cell more than two-thirds as wide at base as at apex; upper cell of hind wings exceeding lower; stigma broad, ovate, not attenuated; sheath rather robust, rugose and with numerous hairs. Color of head and thorax for the most part, basal plates, first segment of abdomen dorsally, sheath, cerci, extreme bases of hind coxæ, tips of hind femora, apical two-thirds of hind tibiæ, and all of hind tarsi black; extreme tips of clypeus and the labrum, palpi, outer angles pronotum, tegulæ, abdomen, and legs, except as noted, rufous; basal third of hind tibiæ whitish; veins and stigma in general brown; costa and some of posterior veins light.

Two females. Maryland (Coll. Am. Ent. Soc.), and Ithaca, N. Y., N. Banks, collector (Coll. U. S. Nat. Mus.).

19. Pteronus corylus Cresson.

1880. *Nematus corylus* Cresson. Trans. Am. Ent. Soc., VIII, p. 8.
1895. *Nematus corylus* Dyar. Trans. Am. Ent. Soc., XXII, p. 306.

Female.—Length 6 to 7 mm.; head and thorax rather coarsely punctured, somewhat shining; clypeus very shallowly emarginate, lobes very short and broadly rounded; frontal crest and sides of ocellar basin distinctly elevated, former unbroken, or rarely indistinctly so; antennal fovea broad and shallow, antennæ long, tapering, third joint longer than fourth; venation normal, second transverse cubital nearly as long

as third; stigma robust, rounded on lower margin; sheath not very robust, rounded at apex, and with rather long and dense hairs; cerci long, slender, as long as or longer than third cubital cross vein; claws deeply cleft, rays nearly equal. Color of head, thorax, base of first dorsal sclerite, sheath, extreme tips of posterior femora, apical half—sharply defined—of posterior tibiæ, and their tarsi black; sometimes the dorsal middle of segments 2 to 4 and rarely 6 and the cerci brownish black; bases of antennæ, tips of clypeus, and the labrum, palpi, outer angles of pronotum, tegulæ, legs, and abdomen yellowish ferruginous; posterior femora and abdomen darker; veins and stigma brown; costa yellowish.

Four females, Cresson's types, Pennsylvania (Coll. Am. Ent. Soc.), and seven females bred from larvæ on alder, Cadet, Mo., October 5, 1884 (Coll. U. S. Nat. Mus.). Adults emerged during latter part of March and early in April. The last larval stages and the cocoon are described by Mr. H. G. Dyar, who states that the larvæ are gregarious edge feeders on alder.

20. **Pteronus dyari** new species.

Female.—Length 6 mm.; very robust; clypeus nearly truncate; ocellar basin well defined, with prominent anterior angle; antennal fovea very shallow, indistinct; head and thorax coarsely punctured; antennæ but little shorter than the body, tapering, third joint longest; venation normal; stigma stout, regularly rounded on lower margin; sheath short, stout, scarcely projecting; claws deeply notched, rays subequal. Color black, shining; mouth parts strongly infuscated; angles of pronotum, tegulæ, first to fifth segments of abdomen ventrally and dorsally, yellowish ferruginous; coxæ except bases, trochanters, basal half of posterior tibiæ, whitish; anterior tibiæ and tarsi and anterior and posterior faces of anterior femora, together with bases of middle pair, pallid; wings nearly hyaline, or very slightly infuscated; veins, including stigma and costa to base, very dark brown.

Male.—Length 5.5 mm.; structurally as in female; procidentia long, projecting; antennæ more robust, tapering. Color as in female, except that the abdomen is wholly black and the legs are yellowish, except extreme tips of posterior femora and apical half of posterior tibiæ and their tarsi.

One female and one male. H. G. Dyar, collector, New York. (Coll. Dyar.)

21. **Pteronus fulvicrus** Provancher.

1882. *Nematus fulvicrus* Provancher. Nat. Can., XIII, p. 291.
1883. *Nematus fulvicrus* Provancher. Faun. Ent. Can. Hym., p. 740.
1890. *Nematus salicis* Ashmead. Bull. Colo. Biol. Assn., I, p. 15.
1894. *Nematus salicicola* Dalla Torre. Cat. Hym., I, p. 257.

Female.—Length 8.5 mm.; robust; clypeus broadly but not very deeply notched; walls about ocellar basin distinctly defined; crest

prominent, unbroken; fovea shallow; antennæ tapering, somewhat longer than head and thorax, joints 3 and 4 subequal; second recurrent vein interstitial with second transverse cubital; venation otherwise normal stigma moderately broad; claws deeply cleft, rays equal; sheath robust, obtusely pointed, straight on upper margin. Color black; labrum pallid; tips of anterior femora, all hind femora, and abdomen except apical segment orange yellow, inclined to reddish on legs; legs otherwise black or strongly infuscated; veins dark brown, including costa and stigma; wings slightly smoky, especially centrally.

Three females collected in Colorado: One (Ashmead's type) in Mr. Ashmead's collection; the others in collection of Cornell University. I have since obtained the original type of Provancher, through the kindness of Abbé V. A. Huard, and confirmed the synonymy as above. The type specimen now lacks the abdomen, and was labeled by Provancher *ruficrus* (485), although published as *fulvicrus*. It was captured at St. Hyacinthe (Can.), and is in the Provancher collection.

22. **Pteronus populi** new species.

Female.—Length 7 mm.; clypeus broadly but not deeply notched, lobes broad, rounded; frontal crest very prominent, unbroken; sides of pentagonal area distinctly raised; antennal fovea broad, shallow, not distinctly defined; antennæ slender, slightly tapering, longer than head and thorax, third and fourth joints equal; intercostal vein a little in advance of basal, not inclined; first transverse cubital hyaline; upper middle cell of hind wings extending one-fifth its length beyond lower; second transverse cubital more than half as long as third; stigma not broad, rounded regularly on lower margin; sheath rather broad, excavated slightly above, pointed, and with rather dense whitish hairs at tip; cerci short; claws deeply cleft, rays nearly equal. Color of head and thorax for the most part, basal plates, base of first dorsal segment, terminal segment including sheath and cerci, extreme bases of coxæ, hind tibiæ, hind tarsi, and veins including costa brownish black; tip of clypeus, labrum, posterior orbits, outer angles of pronotum, tegulæ, spot on side of mesothorax, abdomen, and legs except as noted yellowish ferruginous; orbits, mesothorax, abdomen, and femora inclined to reddish; tibæ and tarsi of anterior legs very slightly infuscated.

One female from Massachusetts reared in May, 1888, by Mr. J. G. Jack, from larvæ found on *Populus tremuloides*. (Coll. U. S. Nat. Mus.)

23. **Pteronus hudsonii** Dyar.

1894. *Nematus hudsonii magnus* Dyar, Trans. Am. Ent. Soc., XXII, p. 306.

Female.—Length 10 mm.; rather robust, shining; clypeus very shallowly notched, almost truncate; fovea distinctly excavate, triangular; frontal crest very prominent, unbroken; ocellar basin distinctly defined;

antennal joints 3 and 4 subequal, or fourth a little longer than third; venation normal; stigma very broad, rounded on lower margin; sheath narrow, tapering; claws rather coarsely and evenly notched. Color of head, antennæ, anterior lobe of mesonotum, scutellum, metanotum, terminal segment of abdomen, sheath, and thorax ventrally black, shining; hind tibiæ, except basal third and their tarsi, dark brown; angles of pronotum, tegulæ, lateral lobes of mesonotum, abdomen, and legs except as otherwise noted yellowish ferruginous; clypeus and mouth parts except mandibles, pale; veins dark brown; wings hyaline, fore wings slightly infuscated below stigma.

One female, Dyar's type. (Coll. Dyar.)

This species was reared by Mr. Dyar from a larva collected on poplar.

24. **Pteronus auratus** new species.

Female.—Length 6.5 mm.; not very robust, shining; clypeus broadly, shallowly notched, lobes broad, rounded; frontal crest prominent, extending nearly to orbits, angulated; sides of ocellar basin very minutely raised; antennal fovea triangular, distinctly defined; antennæ long, slender, third and fourth joints subequal; venation normal, third cubital cell less than one-half as wide at base as at apex; stigma moderately broad, regularly rounded on lower margin; sheath narrow, obtusely pointed, bordering hairs very short, minute; cerci scarcely tapering; claws rather minutely cleft, rays subequal. Color as in *californicus*, except that the coxæ are entirely light and the bases of antennæ, spot beneath, angles of pronotum, and tegulæ are whitish.

One female. Washington. (Coll. Am. Ent. Soc.)

This species is closely allied to *californicus*, but differs from it in what appear to be good structural characters.

25. **Pteronus californicus** new species.

Female.—Length 6.5 mm.; robust, glistening; clypeus very broadly and shallowly notched, lobes rather pointed; frontal crest strongly developed, rectilinear, extending nearly to orbits, unbroken; sides of ocellar basin minutely but distinctly raised; antennal fovea deep, broad-oval; intercostal very oblique, anterior to basal; second recurrent nearly interstitial; second transverse cubital more than one-half as long as third; upper middle cell of hind wings exceeding lower; stigma robust; sheath narrow, obtusely pointed; cerci slender, tapering; rays of claws unequal. Color of head, thorax, basal plates, base of first dorsal sclerite, and bases of coxæ black; tip of sheath, posterior tarsi, and wing veins, including costa nearly to base, brown; stigma lighter; clypeus, bases of mandibles and labrum, yellowish white; outer angles of pronotum, tegulæ, palpi, legs and abdomen, including cerci, yellowish ferruginous; upper orbits with slightly reddish tinge.

One female. California. (Coll. Am. Ent. Soc.)

26. **Pteronus antennatus** new species.

Female.—Length 6 mm.; rather robust, shining; clypeus circularly but shallowly notched, lobes minute; ocellar basin distinctly defined, sides sharply raised; frontal crest broad, rounded, unbroken; antennal fovea deep, circular; antennæ very long, slender, almost as long as body, joints 3 and 4 subequal; third cubital cell nearly twice as wide at apex as at base; stigma very broad, regularly rounded beneath; sheath strongly tapering toward rounded apex, nearly straight on upper margin, with very short, inconspicuous pubescence; cerci short, spindle shaped; claws not deeply notched, rays subequal. Color of base of antennæ, more or less about ocelli, occiput, pronotum except outer angles, spot on anterior and lateral lobes of mesonotum, spot about cenchri, basal plates and base of first segment of abdomen, thorax beneath except centers of mesepimera, hind femora except bases, tips of hind tibiæ and their tarsi, brownish-black (one specimen has the thorax dorsally and the epimera altogether black); otherwise reddish ferruginous; coxæ, trochanters, bases of femora and anterior legs for the most part, and the mouth parts lighter yellowish; veins, including costa nearly to base, brown; stigma brown, paler basally; extreme apex of sheath brown.

Two females. New Hampshire. (Coll. Am. Ent. Soc.)
This species comes very near *tricolor*.

27. **Pteronus ribesii** Scopoli.

1763. *Tenthredo ribesii* Scopoli. Ent. Carn., p. 280.[1]
1866. *Nematus ribis* Walsh. Pract. Ent., I, p. 78.
1866. *Nematus ventricosus* Walsh. Pract. Ent., I, pp. 117–125.
1867. *Nematus ventricosus* Norton. Trans. Am. Ent. Soc., I, p. 208. (Cat., etc., p. 70.)
1867. *Nematus trimaculatus* Fitch. Trans. N. Y. Agr. Soc., XXVII, pp. 909–932.
1867. *Nematus trimaculatus* Fitch. 12th Rept. Ins. N. Y., pp. 909–932.
1867. *Nematus ventricosus* Walsh. Pract. Ent., II, pp. 67, 116.
1869. *Nematus ventricosus* Walsh and Riley. Am. Ent., II, pp. 12–22.
1869. *Nematus ventricosus* Saunders. Can. Ent., II, pp. 13–17.
1869. *Nematus ventricosus* Walsh. Can. Ent., II, pp. 9–12; 31–33.
1869. *Nematus ventricosus* Saunders. Can. Ent., II, pp. 47, 93, 112.
1869. *Nematus ventricosus* Bowles. Can. Ent., II, p. 115.
1870. *Nematus ventricosus* Saunders. Can. Ent., II, pp. 146–149.
1870. *Nematus ventricosus* Packard. Packard's Guide, p. 219.
1870. *Nematus ventricosus* Glover. Ann. Rept. U. S. Dept. Agr., p. 77.
1871. *Nematus ventricosus* Bowles. Can. Ent., III, p. 7.
1871. *Nematus ventricosus* Saunders. Can. Ent., III, pp. 25–27.
1871. *Nematus ventricosus* Jones. Can. Ent., III, p. 37.
1872. *Nematus ventricosus* Packard. 3d Mem. Peabody Acad., pp. 1–17.
1874. *Nematus ventricosus* Riley. 6th Rept. Ins. Mo., pp. 43, 149.

[1] The above bibliography omits all European literature except the first description and the last generic reference, and also many of the shorter or less important American writings.

1874. *Nematus ventricosus* Provancher. Nat. Can., VI, pp. 186–192.
1874. *Nematus ventricosus* Cook. 4th Ann. Rept. St. Pom. Soc. Mich., pp. 379–380.
1874. *Nematus ventricosus* Saunders. Can. Ent., VI, pp. 101–104.
1877. *Nematus ventricosus* Riley. 9th Rept. Ins. Mo., pp. 7, 10, 21–22.
1877. *Nematus ventricosus* Packard. 9th Rept. U. S. Geol. and Geog. Surv., 1875, p. 787.
1878. *Nematus ventricosus* Provancher. Nat. Can., X, p. 56.
1879. *Nematus ventricosus* Riley. N. Y. Tribune, June 11, 1879.
1880. *Nematus ventricosus* Fuller. Am. Ent., III, p. 92.
1880. *Nematus ribesii* Fletcher. Entom. Mag., XVI, p. 278.
1880. *Nematus ventricosus* Thomas. 5th Rept. (10) Ins. Ill., p. 68.
1881. *Nematus ventricosus* Coquillett. 11th Rept. Ins. Ill., pp. 5, 46–48.
1882. *Nematus ventricosus* Saunders. Can. Ent., XIV, p. 147.
1883. *Nematus ventricosus* Lintner. Proc. Am. Assn., XXXI, pp. 471–472.
1883. *Nematus ventricosus* Lintner. Psyche, IV, pp. 48–51.
1883. *Nematus ventricosus* Lintner. Can. Ent., XV, p. 200.
1883. *Nematus ventricosus* Provancher. Petite Faune Ent. Can., II, p. 188.
1883. *Nematus ventricosus* Fyles. Can. Ent., XV, p. 205.
1883. *Nematus ventricosus* Riley. Stoddart's Encyclo. Amer., I, pp. 135–142.
1883. *Nematus ventricosus* Saunders. Ins. Inj. to Fruits, pp. 339–342, 360.
1885. *Nematus ventricosus* Lintner. 2d Rept. Ins. N. Y., pp. 217–221.
1886. *Nematus ventricosus* Lintner. N. E. Homestead, XX, p. 189.
1886. *Nematus ventricosus* Forbes. Entom. Amer., II, p. 173.
1887. *Nematus ventricosus* Lintner. Popular Gardening, II, p. 120.
1887. *Nematus ventricosus* Lintner. Albany Express, XLI, p. 2.
1888. *Nematus ribesii* Fernald. Mass. Hatch Exp. Sta. Bull., 2, p. 7.
1888. *Nematus ventricosus* Lintner. 5th Rept. Ins. N. Y., pp. 156–157.
1888. *Nematus ventricosus* Harvey. Ann. Rept. Maine Exp. Sta., pp. 182–184.
1888. *Nematus ventricosus* Weed. 7th Ann. Rept. Ohio Agr. Exp. Sta., p. 152.
1889. *Nematus ribesii* Fletcher. Can. Ent., XXI, p. 150.
1889. *Nematus ventricosus* Weed. Bull. Ohio Exp. Sta., II, No. 1, p. 6.
1889. *Nematus ventricosus* Hall. Ins. Life, I, p. 319.
1889. *Nematus ventricosus* Beckwith. Bull. IV, Del. Agr. Exp. Sta., p. 15.
1889. *Nematus ventricosus* Riley and Howard. Ins. Life, I, p. 229.
1889. *Nematus ventricosus* Hulst. Bull. XLVI, N. J. Exp. Sta., p. 8.
1890. *Pteronus ribesii* Konow. Deutsch. Ent. Zeit., XXXIV, p. 246.
1890. *Nematus ventricosus* Hopkins. Ann. Rept. W. Va. Exp. Sta., p. 153.
1891. *Nematus ribesii* Cook. Rept. Mich. Exp. Sta. 1890–91.
1891. *Nematus ribesii* Fletcher. Bull. 11, Can. Cent. Farm (May).
1892. *Nematus ventricosus* Garman. Bull. 40, Ky. Agr. Exp. Sta. (March).

Female.—Length 7 to 7.5 mm.; very robust, short-bodied species; head rugose, punctured, thorax less so; clypeus very broadly and shallowly emarginate, sometimes almost truncate, lobes short and not very broad; frontal crest and sides of ocellar basin not well defined, former entire or indistinctly broken; antennal fovea rather deep at apex, oval; antennæ slender, slightly tapering, third joint longest; intercostal vein considerably anterior to basal, usually at right angles to costa; second recurrent frequently interstitial; third cubital cell usually not longer than outer transverse vein; upper middle cell of hind wings frequently not reaching apex of lower or outer veins interstitial, rarely upper cell exceeding lower cell; stigma moderately robust, rounded on lower margin; sheath rather narrow, rounded at extremity, hairs short; cerci very slender and long, not tapering; claws with rays nearly equal.

Color of head above clypeus except triangle below antennæ, orbits, more or less of antennæ above, center of lobes of mesonotum more or less of scutellum, lower half of mesepimera, metepisterna, extreme tips of posterior tibiæ, posterior tarsi, and tip of sheath brownish black; balance of body and legs luteous; mouth parts, coxæ, and trochanters pallid.

Male.—Length 6 mm.; body short, robust, in general as in female; clypeus scarcely emarginate, slightly produced at center, giving trilobed appearance; antennæ more robust than in female, joints 3 to 5 subequal; procidentia very broad, as broad as long, constricted at base; hypopygium very much narrowed toward apex, which is obtusely rounded. Color of head above clypeus, thorax, including all of epimera, basal plates, more or less of central dorsal area of abdomen, and extreme bases of posterior coxæ brownish black; antennæ, tips of posterior tibiæ and their tarsi, veins, and stigma brownish; antennæ lighter beneath; mouth parts, pronotum tegulæ, base of costa, legs, abdomen beneath, and more or less of lateral dorsal region luteous; orbits, lateral lobes, mesonotum, and basal edges of scutellum more or less tinged with rufous.

Twelve females and five males, from Canada to Missouri. (Colls. U. S. Nat. Mus. and Am. Ent. Soc.)

28. **Pteronus edwardsii** Cresson.

1880. *Nematus edwardsii* Cresson. Trans. Am. Ent. Soc., VIII, p. 7.

Female.—Length 5.5 mm.; robust, shining; clypeus very slightly emarginate, almost truncate, lobes very broad; frontal crest and sides of ocellar basin indistinctly elevated, vertex nearly smooth; antennal fovea broad, triangular, shallow; antennæ tapering, almost as long as the entire body, joint 4 slightly longer than 3; intercostal vein posterior to basal, very little inclined; upper middle cell of hind wings very little exceeding lower; stigma elongate, acuminate; sheath very broad, short, obtusely pointed; cerci rather robust, tapering. Color of head and thorax except basal plates, posterior tarsi and tips of posterior tibiæ, sheath, and cerci brownish black, tinged with rufous—the latter color occurring on the pronotum, tegulæ, lateral margin of lobes of mesonotum, sides of scutellum, and upper half of mesepimera; spot below antennæ, clypeus, labrum, palpi, legs, and abdomen, including basal plates, yellowish ferruginous; antennæ unicolorous, black; wing veins, including stigma and costa, brownish.

One female, Cresson's type. Marin County, Cal. (Coll. Am. Ent. Soc.)

29. **Pteronus militaris** Cresson.

1880. *Nematus militaris* Cresson. Trans. Am. Ent. Soc., VIII, p. 7.
1886. *Nematus militaris* Provancher. Add. Faun. Can. Hym., p. 23.

Female.—Length 7 mm.; exp. al. 14 mm.; moderately robust, shining; clypeus deeply notched, lobes narrow; frontal crest prominent, some-

times slightly broken; antennal fovea shallow, indistinct; mouth parts with rather long yellowish hairs; antennæ very slender, slightly tapering, as long as abdomen, fourth joint a little longer than third; intercostal nerve frequently interstitial with basal, nearly at right angles with costa; upper cell of hind wings exceeding lower; third cubital cell scarcely at all divaricating apically; stigma not very robust, tapering apically; sheath obtusely pointed, straight on upper edge, narrow; cerci as long as terminal joint of antennæ, slender; head and thorax, particularly on lower side, with short, sericeous pile; claws rather minutely cleft, inner ray shortest. Color of head except palpi and sometimes lobes of clypeus, anterior margin of pronotum, band along center of mesonotum, metanotum, metepisterna, basal plates, abdomen above, including sheath and cerci, and tips of posterior tibiæ and their tarsi black; fore tarsi dusky; balance of thorax, venter of abdomen, and legs pale, ferruginous; the venter of abdomen more or less obscure with fuscous, sometimes very dark, approaching black; veins and stigma, including costa to base, dark brown.

Two females from New Hampshire (Coll. Am. Ent. Soc.) and one each from Illinois and Washington (Coll. U. S. Nat. Mus.).

30. **Pteronus thoracicus** Harrington.

1893. *Nematus thoracicus* Harrington. Can. Ent., XXI, p. 58.
1895. *Nematus thoracicus* Dyar. Trans. Am. Ent. Soc., XXII, p. 307.

Female.—Length 6 mm.; robust; clypeus deeply notched, lobes narrow; walls of ocellar basin rounded, crest unbroken; antennal fovea shallow, circular; venation about normal; stigma broad, rounded on lower margin; sheath rather short and robust, regularly rounded at tip; claws evenly but not deeply notched. Color reddish yellow; antennæ, head except tip of clypeus and more or less of mouth parts, apical half (sometimes all) of scutellum, metanotum, center of basal dorsal arcs of abdomen, and sheath black; tips of hind tibiæ and the hind tarsi usually infuscated; veins, including stigma, brown; wings hyaline.

Male.—Length 4.5 mm.; structurally in the main as in female; procidentia apparently nearly wanting. Color black; pronotum, tegulæ, legs, and upper half of mesepimera and venter of abdomen yellowish ferruginous; hind tarsi infuscated.

Redescribed from the type specimen of female loaned by Mr. Harrington and two bred specimens (male and female) received from H. G. Dyar, who reports the larvæ (which he also describes) to feed singly on the lower surface of the leaves of *Amelanchier canadensis*.

I have also examined five specimens, two from Washington and three from Mount Hood, Oreg. (Coll. Am. Ent. Soc.). In some specimens the tergum is strongly infuscated and with more or less black on lobes of mesothorax.

31. **Pteronus odoratus** Dyar.

1894. *Nematus salicis odoratus* Dyar. Can. Ent., XXVI, p. 187.

Female.—Length 5.5 mm.; short, robust, shining; head nearly spherical viewed laterally; clypeus rather narrowly and deeply emarginate; ocellar basin distinctly defined, sides acute, finely raised; frontal crest broad, somewhat broken at middle; antennal fovea broad, circular, shallow; antennæ longer than head and thorax, not very robust, tapering, joints 3 and 4 subequal; venation normal; stigma broadest at base, tapering regularly and acuminately to apex; sheath narrow, rounded at apex; cerci very short, robust; claws not deeply notched, rays subequal. Color of antennæ, spot on vertex including ocelli extending back over occiput, mesonotum, metanotum, abdomen dorsally except narrow lateral margin and apex, and apex of sheath black; scutellum basally and sutures of mesothorax inclined to reddish; posterior tibiæ and their tarsi slightly infuscated; antennæ inclined to ferruginous toward tip, especially beneath; entire venter and otherwise except as noted pallid; veins and stigma except extreme base of costa dark brown.

Male.—Length 5 mm.; moderately robust, shining; clypeus projecting, notch a complete semicircle, lobes long, rounded; ocellar basin distinctly defined; frontal crest not, or very slightly, notched; antennal fovea large, circular, deeply excavated; antennæ very robust, flattened, tapering, joints 3 and 4 subequal; venation normal, except that the third cubital cell is nearly quadrangular; stigma elongate, regularly rounded on lower margin; procidentia short, narrow, rounded at apex; hypopygium flexed so as to appear strongly notched at apex; claws minutely notched, rays subequal. Color of antennæ, head above, frontal crest extending over occiput, mesonotum, metanotum, and abdomen except narrow lateral margin black; face, mouth parts, orbits, lateral dorsal margin of abdomen above, and entire venter light yellowish; posterior tibiæ, particularly at apex, and their tarsi strongly infuscated; flagellum rufous beneath; veins, including stigma and costa, the latter to base, dark brown.

This well-marked species seems to be the one characterized by Dyar (l. c.), who also describes the eggs and larval stages. The eggs and larvæ were found at Woods Hole, Mass., on willow.

Seven females, one collected in August in Maine (Coll. Am. Ent. Soc.), three from Michigan, and three from Ithaca, N. Y. (Coll. Cornell Univ.). The male is characterized from a specimen (Coll. Am. Ent. Soc.) without locality label, evidently one of Walsh's judging from the pinning, and probably collected in Illinois.

32. **Pteronus cornelli** new species.

Female.—Length 7 mm.; moderately robust, shining; clypeus broadly, circularly emarginate, lobes rounded, not broad; ocellar basin deeply

and distinctly excavated; lateral walls rounded; frontal crest strongly developed, divided by narrow depressed line at middle; antennal fovea deep; antennæ slender, strongly tapering, joints 4 and 5 subequal; venation normal; sheath narrow, tapering to rounded tip; claws deeply and evenly notched. Color of antennæ, large spot including ocelli and extending over vertex, dorsum of thorax, and abdomen black; posterior tibiæ darker at tips, with tarsi brown; sheath brown; veins brown, stigma scarcely paler; face, orbits, pronotum, tegulæ, entire venter, with lateral edges of dorsum of abdomen, pallid or resinous.

Male.—Length 5 mm.; slender; antennæ not much stouter than in female; procidentia short, narrow, projecting about its own width. Color as in female, except that the antennæ are fulvous beneath and the pectus is strongly infuscated.

Eleven females and five males (Coll. Cornell Univ.), labeled "Lot 85, sub. 965," dated May to July, 1890.

33. **Pteronus trilineatus** Norton.

1867. *Nematus trilineatus* Norton. Trans. Am. Ent. Soc., I, p. 215. (Cat., etc., p. 77.)
1872. *Nematus trilineatus* Norton. Trans. Am. Ent. Soc., IV, p. 79.
1877. *Nematus trilineatus* Glover. Rept. U. S. Dept. Agric., p. 92.
1880. *Nematus similaris* Norton. Rept. Ent. U. S. Dept. Agric. 1879, p. 224, Pl III, fig. 1.
1881. *Nematus trilineatus* Thomas. 10th Rept. Ent. Ill., 1880, p. 68.
1885. *Nematus robiniæ* Forbes. 14th Rept. State Ent. Ill., 1884, p. 116, Pl. 12, fig. 5.
1886. *Nematus similaris* Harrington. Can. Ent., XVIII, p. 39.
1886. *Nematus similaris* Provancher. Add. Faun. Can. Hym., p. 24.
1890. *Nematus similaris* Packard. Rept. U. S. Ent. Comm., V, p. 369, fig. 136.
1890. *Nematus robiniæ* Packard. Rept. U. S. Ent. Comm., V, p. 370.
1895. *Nematus similaris* Dyar. Trans. Am. Ent. Soc., XXII, p. 301 (larva).

Female.—Length 6.5 to 7 mm.; moderately robust, shining; clypeus broadly, circularly, but deeply emarginate, lobes large, triangular; frontal crest and sides of ocellar basin distinctly defined, former unbroken, curving anteriorly; antennal fovea triangular, sharply defined; antennæ long, slender, tapering, third and fourth joints equal or latter longest; venation normal; intercostal vein slightly inclined; third cubital nearly three times as long as wide at base; stigma moderately robust, widest at center; sheath narrow, smooth, tapering on both edges to rounded tip; cerci slender, not tapering; rays of claws nearly equal. Color reddish yellow; antennæ, spot on head surrounding ocelli and extending over occiput, anterior and lateral lobes of mesonotum, small spot beneath anterior wings, metanotum (except metascutellum, sutures, and lateral margin), abdomen (except lateral margin of segments and last segment), apical half of sheath, and posterior tibiæ and tarsi brownish black; antennæ fulvous beneath toward tips; tips of anterior tarsi dusky; veins, including costa to base and stigma, brown, latter darker basally.

Twelve females from Canada, Massachusetts, New York, Kansas,

South Carolina, and Montana (Colls. Am. Ent. Soc. and U. S. Nat. Mus.), and eight bred specimens, including Norton's type specimen of *similaris* (Coll. U. S. Nat. Mus.). Forbes's *N. robiniæ*, the type of which I have examined, is undoubtedly a light-colored specimen of this species. It differs in lacking the black on the anterior lobe of the mesonotum and the small spot beneath the anterior wings.

34. **Pteronus magus** new species.

Female.—Length 8 mm.; very robust, stout, shining; clypeus very broadly and shallowly notched, lobes small, pointed; ocellar basin distinctly defined, sides faintly raised; crest stout; fovea elongate, rather deeply excavated; antennæ longer than head and thorax, slender, tapering, joints 3, 4, and 5 subequal, fourth slightly longest; venation normal; stigma regularly rounded on lower margin; sheath broad, obtusely pointed, densely hairy at apex and on lower margin; claws large, deeply cleft, rays subequal. Color of spot on head including ocelli extending rather narrowly over vertex, large spot on anterior lobes of mesonotum, spot on apex of scutellum, metanotum, and abdomen dorsally for the most part black; head except as noted, pronotum, entire venter, the lateral edge of abdomen dorsally, more or less of posterior margin of some of the middle segments, yellowish ferruginous; antennæ black basally; flagellum reddish, more or less infuscated, especially at base above; sheath brown; veins brown, stigma and costa lighter, yellowish brown.

One female. Canada. (Coll. Am. Ent. Soc.)

35. **Pteronus quercus** new species.

Female.—Length 4.5 mm.; very robust, shining; clypeus nearly truncate, vertex smooth; ocellar basin indistinctly defined, sides rounded; frontal crest broad, unbroken; fovea defined only on anterior margin; antennæ not much longer than head and thorax, slender, scarcely tapering, third joint longest; intercostal interstitial, nearly at right angles to costa; venation otherwise normal; stigma very broad, ovate; apex of costa greatly thickened, half as broad as stigma; sheath robust, densely clothed with long, whitish hairs at apex and on lower margin; cerci short; claws large, deeply cleft. Color of spot on vertex including ocelli extending back over occiput, mesonotum, metanotum, and abdomen except narrow lateral margin black dorsally; antennæ brownish, inclined to ferruginous beneath; body otherwise pallid; legs, mesepimera, border of spot on vertex, slightly inclined to reddish; veins yellowish brown; stigma and costa yellowish.

One female, bred from larva found in June on oak at Ithaca, N. Y., by Mr. Trelease. Adult emerged March 22. (Coll. U. S. Nat. Mus.)

This insect may fall in the genus *Pontania*.

36. **Pteronus hyalinus** new species.

Female.—Length 7 mm.; rather robust, shining; clypeus very broadly, but not deeply emarginate; ocellar basin with distinctly defined walls;

crest prominent, unbroken; fovea deeply excavated but not distinctly limited; antennæ very slender, tapering, joint 4 a little longer than 3; venation normal, except that the intercostal vein is nearly interstitial with basal; sheath narrow, tapering to rounded tip; claws coarsely but not very deeply notched, rays subequal. Color of antennæ, large spot including ocelli extending over vertex, mesonotum, metanotum, and abdomen dorsally black; orbits, face beneath frontal crest, pronotum, tegulæ, lateral area of thorax, abdomen above, venter and legs altogether yellowish or pallid; pectus brown; tips of posterior tibiæ, tarsi and extreme edge of sheath brownish; stigma and costa hyaline; veins otherwise brown.

One female, reared by Mr. H. G. Dyar from a solitary larva taken feeding on edge of leaf of white birch. The larva was described by Mr. Dyar under the name of *Nematus lateralis* Norton. (Trans. Am. Ent. Soc., XXII, 1895, p. 307.)

37. **Pteronus vertebratus** Say.

1836. *Nematus vertebratus* Say. Bost. Journ. Nat. Hist., I, p. 218.
1859. *Nematus vertebratus* Leconte, Say, Ent., II, p. 678.
1861. *Nematus vertebratus* Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 158.
1867. *Nematus vertebratus* Norton. Trans. Am. Ent. Soc., I, p. 215. (Cat., etc., p. 77.)
1880. *Nematus dorsivittatus* Cresson. Trans. Am. Ent. Soc., VIII, p. 10.
1895. *Nematus dorsivittatus* Dyar. Trans. Am. Ent. Soc., XXII, p. 303.

Female.—Length 6 mm.; rather robust, shining; clypeus distinctly but not very broadly emarginate, lobes rounded; sides of ocellar basin distinctly, rather sharply raised; frontal crest rounded, broken at middle; antennal fovea circular, shallow; antennæ very long, slender, considerably longer than head and thorax; joints 3 to 5 subequal; venation normal; stigma moderate, circular on lower margin; sheath rather pointed, lower margin regularly rounded, upper straight or slightly concave, bordering hairs very minute; cerci slender, scarcely tapering; claws not very deeply notched, rays subequal. Color light yellowish; antennæ, spot on vertex including ocelli extending back over occiput, lobes of mesonotum except lateral edges, metanotum, and tergum centrally except apex of last sclerite black or dark brown; antennæ lighter beneath; upper margins of hind tibiæ and their tarsi more or less infuscated; extreme tip of sheath brownish; veins brownish, including costa nearly to base; stigma unicolorous, pale.

Male.—Length 4 mm.; slender, shining; antennæ as long as the body of the insect; structurally in general as the female; antennal joints decreasing uniformly in length from third to tip; fovea somewhat triangular, extending laterally over base of antennæ; procidentia narrow, nearly twice as long as wide, slightly notched at tip. Color of antennæ basally above, spot including ocelli and extending over occiput, mesonotum, metanotum, and dorsum of abdomen black; face below frontal crest, orbits, pronotum, tegulæ and entire venter, yellowish; antennæ

fulvous beneath and toward tip, somewhat infuscated above; posterior tibiæ and tarsi infuscated; wings hyaline; stigma and costa pale.

Two females. Nevada and California. (Coll. Am. Ent. Soc.)

What is possibly the male of this species is described from specimens received from Mr. H. G. Dyar, labeled "S. F. 3H." Cresson's *dorsivittatus* can not be distinguished from this species from the description, and seems synonymous with it. The type of *vertebratus* is lost. According to Mr. H. G. Dyar, who describes the egg and the larval stages from specimens collected at Plattsburg, N. Y., this species is a solitary edge feeder on poplar.

38. **Pteronus integer** Say.

1836. *Nematus integer* Say. Bost. Journ. Nat. Hist., I, p. 218.
1859. *Nematus integer* Leconte. Say Ent., II, p. 679.
1861. *Nematus integer* Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 158.
1867. *Nematus integer* Norton. Trans. Am. Ent. Soc., I, p. 216. (Cat., etc., p. 78.)
1883. *Nematus integer* Packard. Rept. U. S. Ent., pp. 149–150.
1890. *Nematus integer* Packard. Rept. U. S. Ent. Comm., V, pp. 838–840.

Female.—Length 6 to 6.5 mm.; robust, shining; clypeus circularly emarginate, lobes small, rounded; ocellar basin distinctly limited; frontal crest large, slightly broken at middle; antennal fovea expanding basally; antennæ very long, slender, distinctly tapering; stigma not very broad; venation normal; cerci robust, tapering; sheath rather narrow, slightly concave above, rounded at apex; claws not very deeply notched, inner ray distinctly shorter than outer. Color of spot on head, including ocelli and extending to bases of antennæ, center of anterior lobes of mesonotum, metanotum, and central portion of abdomen dorsally brownish black; antennæ dark brown, reddish beneath and apically; tibiæ and tarsi slightly infuscated; sheath narrowly tipped with brown; body otherwise pallid; veins, including costa, light yellowish brown; stigma yellowish hyaline.

Two females. Colorado and New Jersey. (Coll. Am. Ent. Soc.)

39. **Pteronus mendicus** Walsh.

1866. *Nematus mendicus* Walsh. Proc. Ent. Soc. Phila., VI, p. 261.
1867. *Nematus trivittatus* Norton. Trans. Am. Ent. Soc., I, p. 218. (Cat., etc., p. 80.)
1867. *Nematus mendicus* Norton. Trans. Am. Ent. Soc., I, p. 220. (Cat., etc., p. 82.)
1878. *Nematus mendicus* Provancher. Nat. Can. X, p. 58.
1883. *Nematus mendicus* Provancher. Faun. Ent. Can. Hym., p. 191.
1895. *Nematus mendicus* Dyar. Trans. Am. Ent. Soc., XXII, p. 302.

Female.—Length 5 to 6 mm.; not very robust, shining; clypeus broadly but not deeply notched, lobes rounded; ocellar basin with distinctly defined but rounded lateral walls; frontal crest prominent, broken at middle, or strongly bituberculate; antennal fovea broad, shallow; antennæ longer than head and thorax, very slender, tapering,

joints 3 and 4 subequal; venation normal; stigma broad, regularly rounded on lower margin; sheath tapering, straight or slightly concave on upper margin; cerci short, robust; claws deeply cleft, rays unequal. Color very light yellowish; very narrow border of ocelli, small spot on occiput, sometimes line on anterior lobe of mesonotum, spot on lateral lobes of mesonotum (sometimes subobsolete), apex of scutellum, spot between cenchri, brownish black; posterior tibiæ and tarsi very slightly infuscated; antennæ brown ferruginous, the latter color predominating toward tip; sheath sometimes tipped with brown; veins light yellowish brown; costa and stigma greenish hyaline.

Male.—Length 4.5 to 5 mm.; slender, shining; structural characters in general of female; procidentia narrow, projecting, squarely truncate at apex, about as wide as long. Color of antennæ above and basally, large spot on vertex including ocelli and extending over occiput and covering entire base of head, mesonotum, metanotum, and abdomen except lateral margins of segments black; upper orbits, venter, abdomen, and legs for the most part yellowish ferruginous; lower orbits and face below frontal crest and mouth parts pallid; tibiæ and tarsi, particularly posterior pair, infuscated; lower surface of flagellum rufous; veins brown; costa and stigma somewhat lighter, yellowish brown.

Nine females, Illinois, Pennsylvania, and New York (Coll. Am. Ent. Soc.), and from Missouri, Kansas, and Iowa (Coll. U. S. Nat. Mus.).

Three males. Massachusetts and California. (Coll. Am. Ent. Soc.)

For a discussion of the habits of this species, which Mr. Walsh erroneously supposed to be inquilinous in the galls of other Nematines, see Proc. Ent. Soc. Wash., III, p. 267. Mr. H. G. Dyar has described the early stages from material collected on willow in New York City and at Plattsburg, N. Y.

40. **Pteronus vancouverensis** new species.

Female.—Length 6.5 to 7 mm.; not very robust, shining; clypeus broadly emarginate, lobes broad; antennal basin with sharply raised defining walls; crest prominent, bilobed or bituberculate; fovea not distinctly defined; antennæ slender, elongate, fourth joint a little longer than third; venation normal; sheath narrow, tapering, pointed; claws very minutely but evenly cleft. Color pallid, inclined to resinous; antennæ black above, yellowish beneath; anterior lobes of mesonotum brownish, infuscated centrally; tip of scutellum with spot on either side and spots on center of metanotum black; costa and stigma hyaline, veins otherwise dark brown; extremities of legs very slightly infuscated, together with extreme tip of sheath.

Male.—Length 6 mm.; slender, shining; procidentia projecting considerably more than its width, narrow, squarely truncate at tip; claws minutely and evenly cleft. Color of antennæ above, large spot including ocelli and extending over vertex and occiput, lobes of mesonotum except scutellum and metanotum, most of basal abdominal segment

above, together with transverse stripe on each of succeeding segments, dark brown or black; mouth parts, orbits, and area about base of antennæ, pronotum, tegulæ, scutellum, venter with most of lateral dorsal area of abdomen and sutures of segments, and legs yellowish resinous; face paler; hind tibiæ and tarsi slightly infuscated; antennæ yellowish beneath.

Four females. Vancouver Island, Alameda and Placer County, Cal., and Nevada. (Colls. U. S. Nat. Mus. and Am. Ent. Soc.)

One male. Alameda, Cal., Mr. Koebele, collector. (Coll. U. S. Nat. Mus.)

41. **Pteronus koebelei** new species.

Female.—Length 5 mm.; robust, shining; clypeus deeply emarginate, lobes broad, rounded; ocellar basin sharply defined; crest unbroken at middle, straight; antennal fovea very broad, extending laterally from base of antennæ; venation normal, except that the sides of the third cubital cell are parallel; stigma broad, regularly rounded on lower margin; sheath regularly tapering on upper and lower margins to rounded apex, hairs very minute except at extreme apex, where a small tuft of longer hairs occurs; cerci long, slender, slightly tapering; claws deeply notched, rays nearly equal. Color light greenish yellow, with purple tinge on head and thorax; spot including ocelli, more or less of base of head, spot on anterior extremity of the middle lobe of mesonotum extending backward in a narrow line, spot on lateral lobes of mesonotum, one on either side of scutellum, two just within the cenchri, and small spots on basal plates black; antennæ black, sometimes ferruginous beneath; legs, especially tarsi, with distinct greenish cast; veins brown, stigma and costa greenish yellow.

Five females. California and Oregon. (Coll. U. S. Nat. Mus.)

42. **Pteronus pinguidorsum** Dyar.

1895. *Nematus pinguidorsum* Dyar. Trans. Am. Ent. Soc., XXII, p. 303.

Female.—Length 8 mm.; robust, shining; clypeus deeply, circularly emarginate, lobes broad, circular, rounded at tip; ocellar, basin distinctly defined, lateral walls not very sharply raised, crest unbroken, fovea deep, extending laterally over bases of antennæ; antennæ slender, tapering, joints 3 and 4 subequal; venation normal; stigma narrow, sides almost parallel, rather abruptly truncate at tip; sheath robust, obliquely truncate at tip; claws strong, deeply notched. Color light yellow, inclined to pallid; small spot connecting ocelli, antennæ above, and anterior edge of cenchri dark brown or black; anterior lobes of mesonotum brownish purple, head above tinged with purple; antennæ beneath yellowish; posterior tibiæ toward tips and all tarsi very slightly infuscated; extreme tip of sheath brown; stigma yellow; veins dark brown; wings hyaline.

One female, Dyar's type. Mr. H. G. Dyar characterizes the last larval stages from solitary larvæ found on the edges of the leaves of white birch at Keene Valley, N. Y.

43. **Pteronus unicolor** new species.

Female.—Length 6 mm.; moderately robust, shining; clypeus broadly and shallowly emarginate, lobes small, rather pointed; ocellar basin distinctly defined; frontal crest narrow, unbroken; antennal fovea broad, rounded, subtriangular, deeply excavated; venation normal; stigma elongate, acuminate; sheath tapering on lower margin to rather pointed apex, superior margin straight or but slightly convex; claws deeply notched, rays equal. Color uniformly yellowish ferruginous, the latter color most noticeable on vertex, dorsum of thorax and abdomen and the tips of hind femora, all the tibiæ and tarsi; veins brown, except extreme base of stigma, which is white; costa somewhat paler than other veins, especially at base.

One female. California. (Coll. Am. Ent. Soc.)

44. **Pteronus longicornis** new species.

Male.—Length 6 to 7 mm.; not very robust, shining; clypeus shallowly and broadly emarginate; sides of ocellar basin and frontal area rounded, indistinct; antennal fovea shallow, indistinct; antennæ very long, slightly tapering, nearly as long as body, joints nodose at tips, lower ones flattened, joints 3 to 5 subequal; procidentia very broad, one-third as wide as last segment, rounded at tip, strongly constricted basally; claws deeply notched, rays subequal; intercostal vein nearly at right angles to costa and its own length anterior to basal vein; third cubital cell nearly twice as wide at apex as at base and three to four times as long as wide at base; venation otherwise normal; stigma rather broad, ovate, rounded beneath, with slight angle near center. Color black; clypeus, mouth parts, angles of pronotum, tegulæ, narrow lateral margin of abdomen with posterior margin of the central segments and the two terminal segments, venter of abdomen, and legs yellowish ferruginous; tips of the posterior tibiæ and their tarsi, black; veins, including stigma and costa, the latter nearly to base, dark brown.

Many specimens. Michigan, New York, and Long Island (Coll. U. S. Nat. Mus.), and Massachusetts and Canada (Coll. Am. Ent. Soc.)

45. **Pteronus iridescens** Cresson.

1880. *Nematus iridescens* Cresson. Trans. Am. Ent. Soc., VIII, p. 5.

Male.—Length 5 to 6 mm.; not very robust, shining; clypeus circularly and rather deeply emarginate; ocellar basin large, lateral walls and frontal crest distinctly defined, the latter unbroken; antennal fovea very shallow, indistinct, elongate; antennæ robust, flattened, short, not much longer than head and thorax, tapering, joints 3 and 4

subequal; procidentia narrow, truncate, not projecting; claws not very deeply notched, rays subequal; intercostal vein at right angles to costa; third cubital cell elongate, scarcely divaricating; stigma not very broad, rounded on lower margin; venation otherwise normal. Color black; clypeus, labrum, palpi, extreme angles of pronotum, tegulæ, apices of coxæ, tips of femora, including nearly all of anterior pairs, anterior tibiæ, and tarsi more or less light yellowish; posterior tibiæ and tarsi infuscated, anterior tarsi indistinctly so; veins dark brown, including costa nearly to base; stigma brown, unicolorous.

Two males, Cresson's type specimens, from Nevada and one from southern California. (Coll. Am. Ent. Soc.)

46. **Pteronus decoratus** Provancher.

1888. *Nematus decoratus* Provancher. Add. Faun. Can. Hym., p. 369.

Male.—Length 5.5 mm.; rather robust, shining; clypeus very broadly, rather shallowly emarginate, lobes small, rounded; ridges about ocellar basin indistinct and rounded; vertex smooth, glistening; antennal fovea scarcely present; antennæ rather stout, tapering, not longer than head and thorax, joints 3 to 5 subequal; procidentia minute, scarcely projecting; venation normal; stigma not very broad; apex of costa greatly enlarged, almost as large as stigma; claws deeply cleft, inner ray parallel with outer. Color black, shining; orbits, face below antennæ, pronotum, tegulæ, and legs for the most part pallid; femora except line on under side, apices of hind tibiæ together with lower edges of same, and the hind tarsi brown; hind coxæ brown, except at tip; wings nearly hyaline, veins yellowish brown, stigma and costa somewhat paler.

Redescribed from Provancher's type specimen, kindly loaned me by Abbé Huard. The specimen was collected in Florida by Mr. Ashmead. It is distinct from any other known species of the genus and represents the extreme southern range of this group of sawflies. In characters of the vertex it is not typical of the genus to which it is assigned, although in characters of claw and otherwise it seems to be a *Pteronus*.

47. **Pteronus lombardæ** new species.

Male.—Length 5.5 mm.; rather slender, shining; clypeus shallowly but distinctly emarginate; vertex smooth, glistening; ridges about ocellar basin rounded but distinct; venation normal; intercostal very slightly inclined; stigma moderately broad, rounded on lower margin; procidentia narrow, short, blunt; claws rather minutely notched, rays subequal. Color black; clypeus, labrum, palpi, tegulæ, and legs from trochanters outward except posterior tibiæ and tarsi yellowish ferruginous; posterior tibiæ, except bases, and their tarsi strongly infuscated; veins and stigma dark brown; wings very faintly infuscated, almost hyaline.

Three males, one from Lansing, Mich., labeled "Lombardy poplar," and two specimens bred from larvæ on willow by Mr. Dyar (Coll. U. S. Nat. Mus.).

Mr. Dyar, for whom I determined as above some bred males, thinks this may prove a seasonal form of *ventralis* (Trans. Am. Ent. Soc., XXII, 1895, p. 305). Mr. Dyar's specimens were obtained in New York on *Salix*, and, together with the types, present what seem to be good specific differences from *ventralis*.

48. **Pteronus dubius** new species.

Male.—Length 5.5 mm.; clypeus broadly emarginate, almost truncate; frontal crest very large, strongly angled anteriorly, lateral walls of basin tapering rapidly posteriorly; antennal fovea narrow, breaking slightly through crest; antennæ robust, flattened, joints 4 and 5 a little longer than 3; venation about normal; second recurrent interstitial or nearly so in fore wings and the outer veins of discal cells interstitial in hind wings; stigma rather narrow, rounded on lower margin; procidentia short, not very broad, apex rounded; claws deeply divided, rays subequal. Color black, shining; clypeus and other mouth parts and extending to eyes whitish; narrow line on venter of abdomen, including all of hypopygium and the legs, ferruginous yellow; bases of coxæ black; wings hyaline; veins and stigma brown.

One male. Wellesley, Mass., March 29. (Coll. U. S. Nat. Mus.)

49. **Pteronus stigmatus** Norton.

1861. *Nematus stigmatus* (Harris) Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 161.
1867. *Nematus stigmatus* Norton. Trans. Am. Ent. Soc., I, p. 221. (Cat., etc., p. 83.)

Female.—Color greenish luteous; body short and stout; antennæ moderate, the two basal joints black; a small black spot about each of ocelli; clypeus hardly emarginate; labrum angulate, hairy; part of mesothorax, the metathorax, the first seven segments of tergum and ovipositor sheaths, and a spot on pleura below wings black; legs pale; tips of tarsi and claws blackish; wings hyaline; stigma and costa pale green.

One female. Massachusetts. (Harris's Coll.)
It has the size and form of *N. monochroma*.

50. **Pteronus monochroma** Norton.

1861. *Nematus monochroma* (Harris) Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 161.
1867. *Nematus monochroma* Norton. Trans. Am. Ent. Soc., I, p. 221. (Cat., etc., p. 83.)

Female.—Color honey yellow; body stout; antennæ wanting, except two basal joints, which are color of body; ocelli black, set in an irregular depression; clypeus retracted, crenate; labrum angulate; face immaculate; tegulæ, collar, venter, and coxæ paler than rest of body; pleura dark, almost piceus; legs color of body; wings hyaline; stigma and costa pale yellow.

One female. Massachusetts. (Harris's Coll.)
Resembles *N. luteus*, of Europe.

The last two species, Nos. 49 and 50, I have been unable to recognize in the material examined. The type specimens are lost, and I quote without alteration Norton's original descriptions.

IX. Genus AMAURONEMATUS Konow.

Amauronematus Konow. Deutsche Entom. Zeits., XXXIV, 1890, p. 237.

Body large; clypeus emarginate at apex; claws bifid; antennæ short, subsetaceous, usually black; stigma elongate, ovate at base, elongate-acuminate toward apex; head, mesonotum, and mesopleura finely and closely punctured and more or less opaque; head subtriangular; labium long, protruding; sheath of female thick, usually large.

This genus, characterized as above by Konow, includes a group of distinctly differentiated and closely allied species, the American representatives of which may be separated by the aid of the following table:

TABLE OF SPECIES.

Inner tooth of claw small and comparatively inconspicuous ..... 1. *luteipes* Cr.
Inner tooth or ray of claw large and nearly parallel with outer.
Body black dorsally; wings smoky.
Legs altogether black.
Venter of abdomen black; clypeus nearly truncate at apex.
2. *concolor* Nort.
Venter of abdomen pale; clypeus distinctly emarginate.
3. *comstocki* n. sp.
Tibiæ yellowish.
Clypeus and labrum pale; walls of ocellar basin distinctly defined.
4. *gracilis* n. sp.
Clypeus and labrum black; walls of ocellar basin somewhat indistinct.
5. *rapax* Cr.
Body black dorsally; wings hyaline.
Abdomen black ventrally.
Legs, except apical half of hind tibiæ, red..... 6. *rufipes* n. sp.
Legs black except at joints ..... 7. *cooki* n. sp.
Legs with tips of the femora and the tibiæ and tarsi pale.
Pronotum and tegulæ black; clypeus circularly emarginate.
8. *borealis* Marlatt.
Pronotum and tegulæ pale margined; clypeus nearly truncate.
9. *nigrofemoratus* Cr.
Pronotum broadly margined and tegulæ altogether pale; clypeus deeply emarginate, lobes triangular ..... 10. *orbitalis* n. sp.
Abdomen pale ventrally..... 11. *oregonensis* n. sp.
Head and thorax usually more or less marked with black.
Abdomen black dorsally.
Stigma broadest at base; lobes of clypeus broad, rounded.
12. *fulvipes* Nort.
Stigma widest at middle; lobes of clypeus small, triangular.
13. *pectoralis* Cr.
Abdomen yellow; wings smoky; legs black ..... 14. *luteotergum* Nort.
Abdomen yellow; wings clear or nearly so; legs pale.
Antennæ moderately robust, strongly tapering; sheath elongate, narrow, scarcely tapering, tip rounded.

Crest broken; mesonotum with three black stripes. 15. *discolor* Cr.
Crest slightly or not at all broken; mesonotum pale or with a single narrow stripe ..... 16. *lineatus* Harr.
Antennæ moderately robust, strongly tapering; sheath strongly tapering toward tip, latter obtusely pointed.
Anterior lobes, mesonotum, and tip of scutel black.
Stigma and costa dark brown ..... 17. *chalceus* n. sp.
Stigma and costa yellow ..... 18. *coquilletti* n. sp.
Anterior lobes, etc., pale ..... 19. *brunneus* Nort
Antennæ moderately robust, strongly tapering; sheath as above, but sharply produced at tip; clypeus deeply emarginate. 20. *excavatus* n. sp.
Antennæ long and slender, setaceous ..... 21. *californicus* n. sp.

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brunneus Norton, ♀ 19
californicus n. sp., ♀ 21
chalceus n. sp., ♀ 17
comstocki n. sp., ♀ 3
concolor Norton, ♂ 2
cooki n. sp., ♂ 7
coquilletti n. sp., ♀ 18
discolor Cresson, ♀ 15
excavatus n. sp., ♀ 20
fulvipes Norton, ♀ 12
gracilis n. sp., ♀ 4
lineatus Harrington, ♀ 16
luteipes Cresson, ♀ 1
luteotergum Norton, ♀ 14
nigrofemoratus Cresson, ♀ 9
orbitalis n. sp., ♀ 10
oregonensis n. sp., ♀ 11
pectoralis Cresson, ♀ 13
rapax Cresson, ♂ 5
rufipes n. sp., ♂ 6

1. Amauronematus luteipes Cresson.

1880. *Nematus luteipes* Cresson. Trans. Am. Ent. Soc., VIII, p. 6.

Female.—Length 6.5 mm.; exp. al. 14 mm.; very robust, shining; finely pubescent; clypeus deeply and circularly emarginate, lobes narrow, rounded; frontal crest and sides of ocellar basin indistinct or wanting; antennal fovea very shallow, almost wanting; antennæ short, not much longer than head and thorax, rather slender, scarcely tapering, joints 3, 4, and 5 subequal; intercostal vein nearly interstitial with basal; third cubital cell scarcely longer on upper margin than wide at base; discal cells of hind wings with outer veins interstitial or nearly so; sheath narrow, obliquely truncate at apex; inner ray of claw minute, tooth like, and very near apex. Color brownish black; clypeus, labrum, bases of mandibles, orbits, particularly posteriorly, angles of pronotum, tegulæ and legs except bases of coxæ, more or less of apical margin of segments of abdomen, particularly ventrally, yellowish fulvous; sheath and cerci fulvous; veins, including stigma and costa, brown; wings slightly infuscated.

One female. Nevada. (Coll. Am. Ent. Soc.)

In the structure of the claw, this species diverges somewhat from the genus to which it is now assigned and approaches the structure occurring in *Pachynematus*. In general characters, however, it falls under *Amauronematus*.

2. **Amauronematus concolor** Norton.

1867. *Nematus concolor* Norton. Trans. Am. Ent. Soc., 1, p. 196. (Cat., etc., p. 58.)
1867. *Nematus violaceipennis* Norton. Trans. Am. Ent. Soc., 1, p. 201. (Cat., etc., p. 63.)
1886. *Nematus concolor* Provancher. Add. Faun. Can. Hym., p. 22.

Male.—Length 6.5 to 7 mm.; exp. al. 15 to 16 mm.; slender species; clypeus very slightly emarginate, almost truncate; crest and sides of ocellar basin nearly obsolete, indistinct; antennal fovea small, very elongate; antennæ longer than head and thorax, rather robust, flattened, fourth joint longer than third; intercostal its own length anterior to basal, strongly inclined; third cubital more than twice as long as wide at base; venation otherwise normal; procidentia very minute and squarely truncate or broadly excavated at apex; hypopygium broad and squarely truncate at apex, or slightly emarginate. Color black, with hairy pubescence on sides of thorax; clypeus, labrum, cheeks, and bases of mandibles whitish; upper and outer orbits faintly tinged with rufous; wings infuscated; veins, including costa and stigma, brown.

Two males. Maine and Michigan. (Colls. Am. Ent. Soc. and U. S. Nat. Mus.)

A single male collected in Massachusetts agrees exactly with the above in all structural characters, and differs only in that the abdomen is lighter, inclining to reddish, strongly infuscated, especially on the tip and base. This is Norton's *Nematus violaceipennis*, which undoubtedly belongs to *concolor*. I have seen a specimen also from Natick, Mass., collected April 19. (Coll. Cornell Univ.)

3. **Amauronematus comstocki** new species.

Female.—Length 9 mm.; rather elongate, slender; clypeus very shallowly emarginate; walls of ocellar basin rounded, indistinct, frontal crest almost wanting; antennal fovea shallow, elongate; antennæ short, joints 3 to 5 subequal, fourth longest; wing venation normal, stigma slightly angulated near middle; sheath obliquely truncate at tip. Color dull black; oral region, together with outer orbits and triangle at base of antennæ, most of pronotum, and venter of abdomen yellowish white; labium and palpi dark brown, pronotum marked with one or more circular brown spots; apical ventral segments more or less brown; sheath black; legs uniformly black, including joints; wings strongly infuscated; veins black.

One female. Ithaca, N. Y., May 2. (Coll. Cornell Univ.)

This species is very closely allied to *gracilis* in general appearance, but seems to be distinct by the structural characters of the vertex as well as colorationally. *A. concolor* Norton, of which males only are known, approaches this species very closely, and breeding records may eventually show the two species to be identical.

4. **Amauronematus gracilis** new species.

Female.—Length 8 mm.; elongate, slender; clypeus rather broadly and shallowly emarginate, lobes triangular; walls of ocellar basin distinctly defined; crest narrow, not extending laterally, slightly broken by deeply excavated, elongate antennal fovea; fourth joint of antennæ longer than third; upper discal cell of hind wings very elongate and considerably exceeding lower; sheath somewhat elongate, rounded at apex; cerci very long and filiform. Color dull brownish black; triangle between bases of antennæ, orbits and oral region, angles of pronotum, more or less of apical ventral segments, joints of legs, including most of the anterior tibiæ, yellowish; stigma and wing veins dark brown; wings slightly infuscated; labium and palpi brown.

Two females. Ithaca, N. Y., May 8, and Natick, Mass., April 19. (Coll. Cornell Univ.)

5. **Amauronematus rapax** Cresson.

1880. *Nematus rapax* Cresson. Trans. Am. Ent. Soc., VIII, p. 4.

Male.—Length 7 mm.; exp. al. 17 mm.; clypeus circularly but not deeply emarginate; frontal crest and sides of ocellar basin subobsolete; antennal fovea broad, shallow, not sharply limited, and extending indistinctly into ocellar basin; antennæ robust, flattened, not longer than head and thorax, joints 3 to 5 subequal, fourth and fifth slightly longer than third; venation normal; stigma broadest near base, tapering uniformly to attenuated apex; procidentia small, strongly keeled, truncate; hypopygium narrow at tip, slightly emarginate; outer ray of claw distinctly longer than inner. Color black, with hoary pubescence, particularly on thorax and legs; tips of femora, tibiæ, and two anterior pairs of tarsi, fulvous; outer orbits tinged with rufous; wings distinctly but not strongly infuscated.

One male. Nevada. (Coll. Am. Ent. Soc.)

6. **Amauronematus rufipes** new species.

Male.—Length 9 mm.; very slender, elongate; clypeus very broadly emarginate; ocellar basin distinctly defined but not deeply excavated; frontal crest not strongly developed, fovea triangular; antennæ very long and slender, fourth joint longest, nearly a third longer than third joint; first cubital cross vein wanting; stigma very elongate, narrow, acuminate; upper cell of lower wings exceeding lower by one-third its length; procidentia short, more than twice as broad as long, truncate; claws coarsely notched. Color black, shining; basal joint of maxillary palpi, all of legs except apical half of posterior tibiæ, reddish; tarsi inclined to yellowish, more or less infuscated, particularly posterior pair; wings hyaline; veins dark brown; costa, including tegulæ, somewhat paler.

One male. Indiana. (Coll. Cornell Univ.)

7. **Amauronematus cooki** new species.

Male.—Length 5 mm.; clypeus moderately and rather narrowly emarginate, lobes small, rounded; frontal crest not extending at all laterally, slightly broken by the shallow antennal fovea; sides of pentagonal area rounded, indistinct; furrows running from occiput to base of antennæ wide and deep; antennæ longer than head and thorax, joints 4 and 5 subequal, longer than 3; venation normal; procidentia short, squarely truncate with sharp angles, keeled; claws deeply notched. Color black; clypeus, oral region and beneath eyes whitish; joints of legs, with more or less of anterior face of tibia and apices of femora, yellowish; wings hyaline; stigma and veins, including costa nearly to base, dark brown; extreme angles of pronotum sordid yellowish.

One male. Michigan. (Coll. U. S. Nat. Mus.)

8. **Amauronematus borealis** Marlatt.

1892. *Nematus borealis* Marlatt. Proc. Acad. Nat. Sci. Phila., 1892, p. 133.

Male.—Length 6 mm.; exp. al. 14 mm.; head and thorax coarsely punctured, body generally more or less shining, particularly the abdomen; clypeus circularly but not deeply emarginate; frontal crest and sides of ocellar basin indistinct; antennal fovea elongate; antennæ rather stout, flattened, joints 4 and 5 with downward curve, fourth joint longest; third submarginal cell very narrow at base, not much more than one-third as wide as at apex; venation otherwise normal; stigma widest and slightly angulated one-third from base, tapering regularly to acuminate apex; procidentia narrow, short, constricted at base, truncate at apex; hypopygium narrow, rounded at tip; claws deeply cleft, rays subequal. Color black; labrum, tip of abdomen, tips of femora, the tibiæ and tarsi, except terminal joints of latter, yellowish or resinous; wings perfectly hyaline; veins dark brown, including costa to base; stigma luteous, with narrow brown border.

One male. Disco Island. (Coll. Am. Ent. Soc.)

9. **Amauronematus nigrofemoratus** Cresson.

1880. *Nematus nigrofemoratus* Cresson. Trans. Am. Ent. Soc., VIII, p. 4.

Female.—Length 6.5 mm.; exp. al. 16 mm.; very robust; clypeus very slightly emarginate, almost truncate; frontal crest and sides of ocellar basin indistinct; antennal fovea shallow, not distinctly defined, elongate; antennæ short, hardly as long as head and thorax, third to fifth joints subequal; intercostal cross vein very near basal, strongly inclined; venation otherwise normal; stigma broadest at base; sheath rather large, rounded on both sides toward the obtuse tip, which bears a dense scopa; cerci slender, medium, scarcely tapering. Color in general black; entire body, particularly the thorax, with a fine sericeus pile; upper and outer orbits, edge of angles of pronotum, border of tegulæ, spot below eyes, tip of clypeus and the labrum, trochanters, tips of

coxæ, tips of femora, tibiæ except extreme tips, yellowish; tips of tibiæ, especially posterior pair, tarsi, and palpi infuscated; wings hyaline; veins, including stigma and costa, brown.

One female. Nevada. (Coll. Am. Ent. Soc.)

10. **Amauronematus orbitalis** new species.

Female.—Length 7 mm.; exp. al. 15 mm.; rather slender; head and thorax finely punctured but more or less shining; abdomen more so; pubescence very minute; clypeus circularly, broadly, and rather deeply emarginate, lobes triangular, sharply pointed; frontal crest slightly broken; side walls of ocellar basin not very distinct; antennal fovea very minute, circular; antennæ very short, not nearly so long as head and thorax, third to fifth joints subequal; intercostal cross vein not half its length anterior to basal; third cubital cell not twice as long as wide at base, nearly quadrate; outer veins of discal cells of hind wings interstitial, or nearly so; venation otherwise normal; stigma narrow, tapering; sheath large, upper edge straight; cerci very long, slender, scarcely tapering. Color black; upper and outer orbits very broadly, inner orbits narrowly, beneath base of antennæ, clypeus, cheeks, outer angles of pronotum, tegulæ, apices of coxæ, trochanters, inner and outer faces of femora, tibiæ, tarsi, apex of abdomen beneath, yellowish fulvous; face inclined to pallid; tips of tarsi, particularly posterior pair, fuscous; sheath and cerci dark brown, almost black; veins brown, except basal two-thirds of costa; stigma brown, somewhat lighter centrally, especially at base.

Two females. Oregon and Colorado (Gillette). (Coll. U. S. Nat. Mus.)

11. **Amauronematus oregonensis** new species.

Female.—Length 7 mm.; exp. al. 15 mm.; head and thorax finely punctured; abdomen shining; clypeus very slightly, circularly emarginate; frontal crest large and broken; ocellar basin not very distinctly defined; antennal fovea distinct, circular; antennæ very slender, scarcely tapering, fourth joint longest; venation normal; stigma narrow, acuminate; sheath narrow, rounded; cerci slender, long, not tapering; claws deeply cleft, rays subequal. Color black; triangle beneath antennæ, orbits broadly except narrowly on inner side, cheeks, clypeus, labrum, bases of mandibles, palpi, angles of pronotum, tegulæ, abdomen beneath, apical margin of penultimate and all of the last dorsal segment, coxæ except at base, trochanters and legs whitish, the face being pallid and semitransparent; legs inclined to fuscous on upper and lower margins, and the tarsi strongly infuscated; sheath and cerci black, the venter more or less spotted with brown; wings hyaline; veins including costa except at extreme base, brown; stigma transparent along the center.

Two females. Mount Hood, Oreg. (Coll. Am. Ent. Soc.)

A specimen from Mr. Dyar differs from the above only in the darker-colored wing veins.

12. Amauronematus fulvipes Norton.

1861. *Nematus fulvipes* (Harris) Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 160.
1867. *Nematus fulvipes* Norton. Trans. Am. Ent. Soc., I, p. 212. (Cat., etc., p. 74.)
1882. *Nematus semirufus* Kirby. List Hym. Brit. Mus., I, p. 148.

Female.—Length 6 mm.; exp. al. 14 mm.; a short, robust species; clypeus shallowly, rather broadly emarginate, lobes short, broad; frontal crest short, strongly raised, and scarcely broken; sides of ocellar basin indistinct or wanting; antennal fovea small, shallow, circular; antennæ medium, third, fourth, and fifth joints subequal; intercostal cross vein very little anterior to basal, and oblique; venation normal; stigma broad near base, tapering regularly to apex; sheath very broad, obliquely truncate, upper angle obtusely pointed; cerci minute, very slender. Spot including ocelli and extending to base of antennæ, center of lobes of mesonotum, apical half of scutellum, metanotum, the abdomen dorsally, sheath, lower half of mesepimera, black; frontal crest, head below antennæ, orbits, pronotum, legs, and venter of abdomen pallid luteous; sutures of mesonotum, upper half of mesepimera, luteous, inclining to reddish; veins yellowish brown; stigma somewhat lighter, particularly at base; tarsi and posterior tibiæ, labium, and palpi very slightly infuscated.

One female. Maine. (Coll. Am. Ent. Soc.)

13. Amauronematus pectoralis Cresson.

1880. *Nematus pectoralis* Cresson. Trans. Am. Ent. Soc. VIII, p. 9.

Female.—Length 6.5 mm.; exp. al. 15 mm.; clypeus broadly emarginate, lobes small, triangular; frontal crest large, not distinctly defined, unbroken; antennal fovea minute, circular, shallow; antennæ short, slender, tapering, fourth joint slightly longer than third; intercostal anterior to basal vein; third cubital cell three times as long as wide at base; venation otherwise normal; stigma not very robust, widest at middle, lower margin circular; sheath moderately robust, obtusely pointed; claws large, rays subequal. Spot on head inclosing ocelli, with branches running to base of antennæ, antennæ, spot on anterior lobe and small spot on lateral lobes of mesonotum, apex of scutellum with spot on following sclerite, metanotum, dorsum of abdomen except terminal segment and narrow lateral margin, sheath, lower half of mesepimera except pectoral spot, upper and lower edges and bases of femora, and extreme bases of coxæ piceus; prothorax beneath, labium, and palpi fuscous; tibiæ and tarsi somewhat infuscated; head and thorax except as noted, abdomen beneath, and legs yellowish ferruginous, inclined to reddish on head and sutures of thorax and mesepimera; veins light yellowish brown; stigma and costa somewhat lighter.

In some specimens the mesepimera are entirely reddish or only slightly infuscated on their lower portion; also part of the face and base of wings are inclined to whitish.

Four females. Colorado and Nevada. (Coll. Am. Ent. Soc.)
This species scarcely differs from *A. fulvipes* Norton.

14. **Amauronematus luteotergum** Norton.

1861. *Nematus luteotergum* Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 161.
1867. *Nematus luteotergum* Norton. Trans. Am. Ent. Soc., I, p. 206. (Cat., etc., p. 68.)
1882. *Nematus luteotergum* Provancher. Nat. Can., XII, p. 291.
1883. *Nematus luteotergum* Provancher. Faun. Ent. Can. Hym., II, p. 740.
1895. *Nematus luteotergum* Dyar. Trans. Am. Ent. Soc., XXII, p. 304.

Female.—Length 8.5 mm.; exp. al. 19 mm.; very robust; head and thorax opaque, abdomen shining, the former covered with a very minute hairy pubescence; clypeus somewhat broadly emarginate, lobes small, rounded; frontal crest and sides of ocellar basin indistinct; antennal fovea elongate, shallow; antennæ as long as head and thorax, fourth joint longer than third; intercostal cross nerve its own length anterior to basal nerve, strongly inclined; second transverse cubital but half as long as third; venation otherwise normal; stigma very narrow, elongate, and acuminate; sheath elongate, obtusely rounded at apex; cerci very long, scarcely tapering; claws deeply notched, the rays almost equal. Color of head and thorax for the most part, usually the dorsal center of basal plates with lateral spot and terminal dorsal segment of abdomen, sheath, legs, cerci, labium, and palpi black; front face of two anterior pairs of femora and tibiæ, paler; terminal joints of antennæ rarely, spot beneath base of antennæ, clypeus, labrum, bases of mandibles, more or less of upper and outer orbits, angles of pronotum, spot on lateral half of basal plates, and abdomen except as noted yellowish ferruginous; veins and stigma, including costa and tegulæ, dark brown; anterior wings particularly infuscated, and with a minute dot near the center of the second cubital cell, also one near the apex of the median cell.

Three females. Massachusetts. (Coll. Am. Ent. Soc.) I have also compared five specimens (females), representing Wellesley and Natick, Mass., and Ithaca, N. Y. (Coll. Cornell Univ.) Mr. H. G. Dyar describes the larvæ of this species from specimens taken on alder, Keene Valley, N. Y.

15. **Amauronematus discolor** Cresson.

1880. *Nematus discolor* Cresson. Trans. Am. Ent. Soc., VIII, p. 8.

Female.—Length 8.5 mm.; exp. al. 18 mm.; large, elongate, moderately robust species; the clypeus rather deeply emarginate, lobes large, rounded; frontal crest strongly elevated; sides of ocellar basin somewhat indistinct; fovea very elongate, shallow, and cutting through the

crest; antennæ short, not longer than head and thorax, slender, tapering, joints 4 and 5 subequal, longer than 3; intercostal cross nerve very oblique, nearly interstitial with basal nerve; second cubital cross vein about half as long as the third; venation otherwise normal; stigma very slender, elongate, and acuminate; sheath narrow, elongate, rounded at apex; cerci very slender, longer than last dorsal segment; claws deeply cleft, rays subequal. Color in general luteous; large spot on head including ocelli, antennal region except spot above clypeus, antennæ, center of anterior lobes of mesonotum, apex of scutellum, metanotum, narrow margin of basal plates, prothorax beneath, spot on outer angles of same, bases of coxæ and trochanters, ventral half of mesepimera, extreme tip of sheath, and the cerci piceus; upper and lower edges of femora and upper edges of tibiæ and tarsi, particularly the posterior pair, fuscous; veins, including stigma, costa, and tegulæ, yellowish brown; a minute dot occurs at the apex of the median cell and near the center of the second cubital cell; anterior wings, particularly, slightly infuscated.

Three females. Colorado. (Coll. Am. Ent. Soc.)

A female collected on willow blossoms at Olympia, Wash. (Coll. Cornell Univ.), differs from the above in being in general lighter colored, the dark markings being generally present but somewhat more restricted. The wing veins and particularly the stigma are lighter, and the mesepimera lack the pectoral dark spot.

16. **Amauronematus lineatus** Harrington.

1893. *Nematus lineatus* Harrington. Can. Ent., xxv, p. 59.

Female.—Length 7.5 mm.; robust, abdomen tapering from near base quite strongly toward apex; clypeus distinctly emarginate, lobes triangular; lateral walls of ocellar basin indistinct; frontal crest large, sharply defined, slightly or not at all broken; fovea triangular; antennæ not so long as head and thorax, tapering, joints 3 to 5 subequal; venation normal; stigma elongate, widest at base, tapering regularly to apex; sheath long, narrow, regularly and equally rounded on both margins to obtuse apex; cerci rather long, slender, scarcely tapering; claws large, deeply cleft, rays subequal. Color yellowish ferruginous; vertex and mesonotum inclined to reddish or with a purplish tinge; antennæ except on scape beneath, narrow line sometimes wanting on anterior lobe of mesonotum, apex of mesoscutellum, metanotum for most part, and the dorsal abdominal segments centrally, narrowing posteriorly, black; extreme upper and outer margin of sheath brown; extreme tips of posterior tibiæ and their tarsi very slightly infuscated; veins light yellowish brown; stigma and costa somewhat lighter yellowish.

Redescribed from the type of this species loaned by Mr. Harrington, and two specimens—one collected in Maine (Coll. Am. Ent. Soc.)

and the other in New York (Coll. U. S. Nat. Mus.). In the former the abdomen is very narrowly black centrally, and only on three or four basal segments. A female (Coll. U. S. Nat. Mus.) taken June 26, at Garland, Colo., is also provisionally placed with this species. It agrees in coloration with the Maine specimen, and also in structure, except that the sheath of the ovipositor is broadened basally.

17. **Amauronematus chalceus** new species.

Female.—Length 10 mm.; large, rather robust; clypeus deeply and broadly emarginate, lobes large, rounded; ocellar basin distinctly defined; frontal crest prominent, not or but slightly broken, extending in an indistinct ridge to the orbits; antennal fovea large, triangular, rather deeply excavated; antennæ distinctly tapering, third and fourth joints very much longer than fifth, third longest; third submarginal cell elongate, sides parallel; upper discal cell of hind wings considerably exceeding lower; sheath broad, tapering, slightly constricted before apex, with distinct scopa at tip; cerci short, slightly constricted at base; claws deeply and evenly notched. Color reddish yellow or resinous; antennæ with circle about base extending downward to clypeus, anterior and lateral lobes of mesonotum, apex of scutellum, metascutum, more or less of center of basal plates, prothorax beneath, and lower half of mesepimera brownish black; ocellar region, posterior tarsi, and tip of sheath more or less infuscated; wings slightly infuscated, especially between stigma and posterior border; veins and stigma dark brown, almost black.

Two females. Olympia, Wash. T. Kincaid, collector. (Coll. Cornell Univ.)

18. **Amauronematus coquilletti** new species.

Female.—Length 8 mm.; robust; clypeus broadly, rather deeply notched, lobes large, rounded; ocellar basin distinctly defined, lateral walls not strongly raised; frontal crest slightly broken by the backward extension of the deep and sharply defined oval antennal fovea; antennæ stout, longer than head and thorax, slightly tapering, densely clothed with short hairs; second recurrent nearly interstitial with second cubital; stigma broad, rounded on lower margin, acuminate; sheath narrow, tapering, slightly but obtusely produced at tip; claws coarsely and evenly notched. Color resinous yellow, inclined to reddish; antennæ, small spot including ocelli with branches running down toward bases of antennæ, stripe on each of anterior lobes of mesonotum, metanotum for the most part, ventral sclerites of prothorax, and lateral sclerites of metathorax black or dark brown; extreme tip of sheath brownish; wings hyaline or slightly smoky from rather dense pubescence; veins uniformly light yellowish brown; stigma and costa somewhat paler.

One female. Los Angeles, Cal. Mr. D. W. Coquillett, collector. (Coll. U. S. Nat. Mus.)

19. **Amauronematus brunneus** Norton.

1864. *Nematus brunneus* Norton. Proc. Ent. Soc. Phila., III, p. 8.
1867. *Nematus brunneus* Norton. Trans. Am. Ent. Soc., I, p. 205. (Cat., etc., p. 67.)

Female.—Length 7 mm.; exp. al. 16 mm.; robust; head and thorax finely punctured, opaque; clypeus sometimes almost truncate, or very slightly emarginate; sides of ocellar basin and frontal crest present but rounded, latter slightly broken; antennal fovea elongate; antennæ not longer than head and thorax, scarcely tapering, slender, joints 3 to 5 subequal; stigma not very broad, elongate, subacuminate; sheath tapering on both edges, somewhat angularly, to an obtuse tip, smooth, margined with very short scattering hairs; claws very large, deeply notched, rays subequal. Color in general very light yellowish; mesonotum and mesepimera dull reddish; antennæ ferruginous, black, or light brown above, growing lighter toward tips; tips of hind tibiæ and their tarsi somewhat infuscated; veins light yellowish brown; stigma, costal, and subcostal veins lighter, unicolorous.

One female. Colorado. (Coll. Am. Ent. Soc.) I have compared also a specimen collected at Ithaca, N. Y. (Coll. Cornell Univ.)

20. **Amauronematus excavatus** new species.

Female.—Length 7 mm.; robust; clypeus deeply and circularly emarginate, lobes narrow, rounded at tip; walls of ocellar basin distinctly defined; frontal crest deeply broken by the backward prolongation of the large oval antennal fovea; antennæ short, fourth joint longest; venation normal; stigma rather broad, circular on lower margin, widest at middle; sheath acuminate, rather pointed at tip; cerci short, inconspicuous. Color resinous, darker on thorax and vertex; ocellar basin and line connecting posterior ocelli black; veins light yellowish brown; stigma and costa lighter yellowish.

One female, without locality label. (Coll. Am. Ent. Soc.) This species seems to be somewhat intermediate between the genus to which it is now assigned and *Pteronus*.

21. **Amauronematus californicus** new species.

Female.—Length 6 mm.; rather robust, shining; clypeus distinctly, circularly notched, lobes rounded; frontal crest broad, stout, unbroken; ocellar basin with rounded, indistinct lateral walls; fovea indistinctly defined, extending laterally over bases of antennæ; antennæ very slender, elongate, filiform, third joint longest; venation normal; stigma elongate, narrow; sheath narrow, squarely truncate at tip; claws evenly but not very deeply cleft. Color light resinous yellow; antennæ brown above; basal joints darker; ocelli with very narrow black border; two black spots just back of mesoscutellum; veins light brown; stigma and costa light yellowish.

Two females. Los Angeles, Cal. D. W. Coquillett, collector. (Coll. U. S. Nat. Mus.)

X. Genus CRŒSUS Leach.

Crœsus Leach. Zool. Misc., III, 1817, p. 129.

The characters distinguishing this genus are indicated in the table of genera. It is closely allied to both *Amauronematus* and *Pteronus* in the characters of the vertex, clypeus, and claws. The original descriptions of the two American representatives are reproduced without change.

Crœsus latitarsus Norton.

1862. *Crœsus latitarsus* Norton. Proc. Ent. Soc. Phila., I, p. 199.
1867. *Crœsus latitarsus* Norton. Trans. Am. Ent. Soc. I, p. 84. (Cat., etc., p. 54.)
1881. *Crœsus latitarsus* Packard. Bull. 7, U. S. Ent. Comm., pp. 129, 184.
1882. *Crœsus latitarsus* Provancher. Nat. Can., XIII, p. 291.
1883. *Crœsus latitarsus* Provancher. Faun. Ent. Can. Hym., p. 740.
1885. *Crœsus latitarsus* Dimmock. Psyche, IV, p. 286.
1888. *Crœsus latitarsus* Jack. Psyche, V, p. 41.
1890. *Crœsus latitarsus* Packard. 5th Rept. U. S. Ent. Comm., p. 485.
1893. *Crœsus latitarsus* Dyar. Can. Ent., XXV, p. 246.
1894. *Nematus* (*Crœsus*) *latitarsus* Dalla Torre. Cat. Hym., I, p. 233.

Female.—Antennæ as long as body, black; body shining, blue black, a crescent-shaped elevation between antennæ; clypeus notched; labrum, mandibles and palpi piceous; mesothorax with confluent longitudinal punctures; legs black, the anterior pair piceous toward tip; posterior trochanters and basal half of all the tibiæ white; posterior tibiæ enlarged and very much flattened toward the tip; first joint of tarsi still wider, compressed, longer than remaining four joints together, its edges elevated to a rim on both sides; wings hyaline, a little smoky below stigma; a dot in middle of both second and third submarginal cells.

Massachusetts (Harris's Coll.), Pennsylvania (Coll. Am. Ent. Soc.). (Smithsonian Institution).

(Three females.) Quite rare. Wild cherry, August 16.

Bred by Mr. Walsh from larvæ feeding on birch.

Crœsus laticulus Norton.

1869. *Crœsus laticulus* Norton. Trans. Am. Ent. Soc., II, p. 368. (Cat., etc., p. 222.)
1894. *Nematus* (*Crœsus*) *laticulus* Dalla Torre. Cat. Hym., I, p. 232.

Female.—Length 0.48 inch; black; tegulæ, a spot on sides of basal plates and of second and third segments of abdomen whitish; apex of mandibles and the legs ferruginous, with the apex of hinder femora, the apical two-thirds of their tibiæ and the most part of the first tarsal joint blackish; antennæ very long (0.36 inch), quite slender; each ocellus at the head of a pentagonal basin; a protuberance between antennæ, nasus incurved; some scattered subobsolete oval punctures on the head and mesothorax; scutel polished; pleura dull, but not punctured; tergum with delicate cross striæ; abdomen slender, cylindrical; hinder tibiæ one-half longer than first and second, somewhat enlarged, twice as wide as the others, with a deep channel down the upper side; all the joints of their tarsi enlarged and flattened, the first joint widest, but not as wide as tibiæ, the patellæ long and white, the claws with a strong inner tooth; wings ample, hyaline; nervures piceous; stigma black; first transverse submarginal nervure obsolete, except its rudiments near the nerves; second recurrent nervure received near the transverse nervure.

Two females. Massachusetts (Coll. Am. Ent. Soc.), Virginia (Peabody Institute, Salem).

XI. Genus HOLCOCNEME Konow.

Holcocneme Konow. Deutsche Entom. Zeits. XXXIV, 1890, p. 232.

Body large; clypeus emarginate at apex; claws bifid or with subapical tooth; head and thorax more or less punctured, but little shining; stigma ovate at base, acuminate at apex, black; posterior tibiæ and tarsi thickened, the former deeply channeled exteriorly; hypopygium of male emarginate at apex; sheaths of female small, thickened.—Konow.

This genus seems to me to be of very doubtful standing. I have found no American representatives, and the European examples show a tendency toward the preceding form (*Crœsus*) in the enlargement of the hind tibiæ and metatarsus. The chief distinguishing character of the genus is the grooving of the hind tibiæ exteriorly, but this occurs to a greater or less extent in practically all Nematids.

XII. Genus NEMATUS Jurine.

Nematus Jurine. Nouv. Méth. Class. Hym., 1807, p. 59.

The characteristics of this genus, as indicated by the table of genera and an examination of the principal European specimens referred to it by Konow, are as follows:

Body robust; antennæ slender, tapering; clypeus more or less emarginate; hind tibiæ and tarsi simple; claws bifid; last ventral segment of the male emarginate at tip, not produced or pointed; eighth dorsal segment of male broadly, obtusely truncate at tip, not at all produced; sheath of female broad and thick and with the last dorsal segment greatly developed and constituting nearly half of the abdomen.

Konow assigned to this genus the group of species represented by the European *Nematus luteus* Pz., *abdominalis* Pz., *bilineatus* Klug., and a few others. The very large and thickened sheath, with long bordering fringe of hairs and large, thick, acuminately pointed ovipositor, together with the enormously developed lateral clasping portion of the last dorsal segment, at once distinguish this genus from all other Nematines. *Nematus unicolor* n. sp. is typical in the features indicated and exhibits a close relationship with *N. luteus* Pz. of Europe. It is the only undoubted representative of this genus as restricted occurring in this country. Of the three other American species, two (*N. pergandei* n. sp. and *N. chloreus* Norton) possess the peculiarities of sheath and ovipositor, but lack the unusual development of the last segment. The third (*N. mexicanus* Cameron) seems from the description to be a true *Nematus*.

The unusual development of ovipositor and adjoining parts in *unicolor* n. sp. and the European species would suggest some peculiarity of habit in ovipositing calling for such modification. Nothing in this direction seems to be indicated by the habits, so far as known, in the absence of direct observation on oviposition. The European species feed on *Alnus*, the larvæ resting on the upper surface of the leaves,

skeletonizing them at first and in their later stages eating entirely through.

Mr. H. G. Dyar has described the larva of *unicolor* n. sp. (Trans. Am. Ent. Soc., XXII, p. 308), the food-plant being white birch, but in feeding habits agreeing with the European species.

TABLE OF SPECIES.

Females.

Last dorsal arc of abdomen enormously developed.
Claws bifid.
Wings slightly infuscated basally; stigma brown basally; dorsum pale. 1. *unicolor* n. sp.
Wings clear; stigma pale; metanotum and abdomen above black. 2. *mexicanus* Cameron.
Claws with minute inner tooth ..... 3. *pontanioides* n. sp.
Last dorsal arc not unusually developed.
Ocellar basin with distinct lateral walls and containing two small tubercles. 4. *pergandei* n. sp.
Ocellar basin with indistinct lateral walls and without tubercles. 5. *chloreus* Norton

1. Nematus unicolor new species.

1895. *Nematus unicolor* Dyar. Trans. Am. Ent. Soc., XXII, p. 308. (Larva.)

Female.—Length 7 mm.; rather robust, shining; clypeus deeply, rather narrowly notched, lobes large, rounded; ocellar basin scarcely present, deep furrow connecting anterior ocellus with antennal fovea; antennæ slender, scarcely tapering, setaceous, about as long as head and thorax, third, fourth, and fifth joints subequal; intercostal nearly at right angles with costa, interstitial or nearly so; third cubital with sides parallel; posterior wings with outer veins of discal cells interstitial, or nearly so; stigma moderately elongate; sheath tapering, pointed, and with terminal abdominal segment enormously developed, representing nearly half of abdomen; cerci very long, slender, almost as long as first joint of hind tarsi; claws rather large, inner ray very distinctly shorter than outer. Color uniformly reddish yellow; wing veins and stigma yellowish brown; antennæ infuscated basally; ocelli very narrowly margined with black; basal plates more or less infuscated; wings hyaline, veins brown, stigma and costa yellow, former brown basally.

Three females, one from Mount Hood, Oreg. (Coll. Am. Ent. Soc.), and two reared by Mr. H. G. Dyar from larvæ on white birch collected in Green Valley, New York (Coll. Dyar).

2. Nematus mexicanus Cameron.

1884. *Nematus mexicanus* Cameron. Trans. London Ent. Soc., p. 481.

Female.—Livid, testaceous; face, sides and apex of abdomen above, and legs obscure livid yellow; antennæ, metanotum, and back of abdomen except at apex, apex of hind tibiæ, and tarsi black; anterior tibiæ inclining to fuscous; wings clear hyaline; costa and stigma whitish yellow; antennæ shorter than the abdo-

men, almost glabrous, third joint a little shorter than fourth; vertex raised in center; frontal area a deep wide depression; antennal fovea large, longer than wide; clypeus deeply incised; palpi fuscous; wings longish; second cubital cellule double the length of third, not angled where the recurrent nervures are received; third cellule a little widened at apex; the second recurrent nervure received a little in front of third transverse cubital; abdomen larger than the head and the thorax together, narrowed toward the apex, its last segment largely developed above; cerci long; ovipositor long, nearly half the length of the abdomen; the sheath at apex pilose; blotch small; cerci large, white; claws bifid, spurs shortish. The vertex and mesonotum are very finely punctured; on the middle lobe of the latter is a central furrow; the extreme apex of the scutellum is black, and there is a narrow obscure black line down its center.

Length 7 mm.

Closely allied to the European *N. hæmorrhoidalis* Spin. and to the North American *N. chloreus* Norton. The occurrence of a *Nematus* so far south is of much interest, this being the first record of that northern genus in Central America.

Habitat: Northern Sonora, Mexico (Morrison).

The type of this species was not procurable and the original description is quoted without alteration.

3. **Nematus pontanioides** new species.

Female.—Length 5 mm.; rather robust; clypeus very deeply and circularly emarginate, lobes rounded; walls about ocellar basin and the frontal crest rounded, indistinct; vertex smooth, shining; antennal fovea broad, shallow; antennæ not longer than head and thorax, slender, filiform, joints 3, 4, and 5 subequal; second recurrent received near second cubital; third cubital cell very elongate, three times as long as wide, narrow; stigma broad; sheath large, tapering, sharply acuminate, occupying with overlapping terminal dorsal sclerite nearly one-half of the abdomen; cerci very long, extremely slender, as long as basal joint of hind tarsi; inner tooth of claw minute. Color honey yellow and dark brown; spot including ocelli and extending to antennæ, anterior lobe of mesonotum, metanotum, abdomen except last segment and sheath, pleura, and pectus brown; antennæ brown, fulvous beneath; femora inclined to brownish; coxæ basally dark brown, almost black; wings nearly hyaline; veins yellowish brown; stigma yellowish hyaline, darker basally.

One female. Mount Hood, Oreg. (Coll. Am. Ent. Soc.)

In character of antennæ and development of ovipositor and last segment of the abdomen, this species is closely allied to *unicolor*, but differs in the structure of the claws. The last segment of the abdomen is enormously developed, and the long, sharply pointed sheath and long cerci may indicate a gall-making habit, whence the designation *pontanioides*. The inner tooth of the claw is very minute and close to the tip, but in spite of this marked divergence from the characters of the claw of the genus the features of abdomen and ovipositor are so striking as not to permit of its being placed elsewhere.

4. **Nematus pergandei** new species.

Female.—Length 7 mm.; exp. al. 15 mm.; very robust, short; head not broadened posteriorly; clypeus broadly, circularly emarginate; lobes broad, obtuse; frontal crest very large, obtusely rounded; lateral walls of ocellar basin sharply defined; basin filled by two tubercles; antennal fovea very broad, shallow; antennæ little longer than head and thorax, very slender, scarcely tapering, joints 4 and 5 subequal, shorter than 3; sheath thick, squarely truncate, tubular; venation normal; stigma ovate at base, tapering rather regularly toward the somewhat truncate apex; claws very deeply cleft, rays nearly equal. Color luteous, shining; face below antennæ, orbits, pronotum, most of venter, and legs, pallid; dorsal area of head, mesonotum, margin of abdomen above, basal half of mesepimera, and sheath reddish yellow; lateral margin of mesonotum, most of metanotum, broad stripe covering dorsal center of the segments of the abdomen except the last, black; antennæ brown, fulvous beneath; ocelli ringed with black and a small black or brownish spot just at base of each antenna; wings hyaline; veins light yellowish brown; stigma and costa yellowish, almost hyaline.

One female. Washington, D. C. (?). (Coll. Am. Ent. Soc.)

5. **Nematus chloreus** Norton.

1867. *Nematus chloreus* Norton. Trans. Am. Ent. Soc., I, p. 221. (Cat., etc., p. 83.)
1872. *Nematus chloreus* Norton. Trans. Am. Ent. Soc., IV, p. 80.
1888. *Nematus chloreus* Provancher. Add. Faun. Can. Hym., p. 348.

Female.—Length 5 to 5.5 mm.; very robust; head and thorax finely punctured, opaque; clypeus nearly truncate; vertex smooth; lateral ridges of ocellar basin not very prominent, rounded; basin very shallow and indistinct; crest rather large, rounded; antennal fovea very shallow, indistinct; antennæ short, not as long as head and thorax, slender, tapering, third joint very little longer than fourth; stigma broad basally, tapering regularly nearly to apex; apex of costa very greatly thickened; sheath thick, short, scarcely projecting, margined with long, not very numerous curved hairs; cerci rather long, slender; claws large, deeply notched. Color yellowish ferruginous; mesonotum, mesepimera, margin of abdomen dorsally, and sheath somewhat inclined to reddish; antennæ, spot on either side of mesoscutellum, apex of same and metanotum except metascutum, basal plates and central area of abdomen above, black; antennæ lighter beneath, especially toward apex; veins brown, stigma and costa yellowish.

Two females from Texas, one Norton's type (Colls. U. S. Nat. Mus. and Am. Ent. Soc.)

In general characteristics this species comes very near *Nematus pergandei* n. sp., but it is less than one-half the size of the latter, and differs in other details.

XIII. Genus PACHYNEMATUS Konow.

Pachynematus Konow. Deutsche Entom. Zeits., XXXIV, 1890, p. 238.

Body short, rather stout; clypeus emarginate at apex; inner tooth of claw generally minute and at right angles to outer; antennæ of the male long, more or less compressed; female shorter, subsetaceous, usually black; pentagonal area of vertex distinct; eighth dorsal segment of the male broad, wide at tip; hypopygium subtriangular, produced at apex; sheath of female short, stout.—Konow.

This genus is characterized chiefly by the short inner tooth of claw projecting nearly at right angles with the claw and the emarginate clypeus, together with the distinctly developed ridges to the ocellar basin (pentagonal area). Its American representatives may be readily divided into three well-marked groups. The first is the smaller of the three groups and is characterized by the large, greatly projecting, and rounded, flattened sheath of the female. The rest of the species are separated into two well-marked groups by the characters of the head and antennæ. In one the head is very strongly developed and widens notably back of the compound eyes, particularly in the case of the females, and with the males the antennæ are very long, cylindrical, and not at all or scarcely compressed. In the other group the head narrows in both sexes back of the compound eyes, and the antennæ in the males are comparatively short, usually robust, and very strongly compressed. The first of these latter subdivisions, or the second group of species, has a typical representative in the wheat and grass sawfly (*Pachynematus extensicornis* Norton), the habits of which are described and illustrated in Insect Life, IV, pp. 174–177, fig. 14. The species was then referred to *marylandicus*, but it now appears that Norton's earlier description of *extensicornis* was of the male of this species. The close similarity of the species in this group in structural characters suggests a like similarity in habits, and we may therefore expect most of them to be grass feeders. They represent all sections of the country, from Maine to California. The third group approaches very closely in characters the following genus (*Lygæonematus*) in that the clypeus is often only slightly emarginate, and the separation and reference is therefore not entirely satisfactory in all cases.

TABLE OF SPECIES.

Females.

I. Sheath very large, projecting free at least one-half its length, not or scarcely tapering, rounded at apex.

Second recurrent usually interstitial; prevailing color black or dark brown.

Lobes of clypeus triangular; clypeus and labrum very hairy; venter infuscated ..... 1. *dimmockii* Cresson.

Lobes broad, rounded; clypeus and labrum nearly smooth; venter pallid. 2. *ruralis* Cresson.

Second recurrent not interstitial; prevailing colors yellow or resinous. 3. *ocreatus* Harrington.

II. Sheath normal, but slightly projecting; tip usually obliquely truncate or tapering; head strongly developed and widening back of compound eyes; second recurrent vein usually interstitial; rather robust species; stigma and costa usually hyaline.

Metanotum more or less yellow; tergum yellow ..... 4. *aurantiacus* n. sp.

Metanotum and tergum black.

Head (except usually a spot about ocelli) and more or less of mesonotum pale.

Mesonotum pale or with two or three black spots; body beneath pale except rarely black spot on pectus and infuscated bases of femora.

Stigma and costa pale; wings hyaline.

Sheath broad, obliquely truncate; large species. 5. *extensicornis* Norton.

Sheath rather narrow, tapering regularly ..... 6. *affinis* n. sp.

Stigma and costa pale; wings infuscated ..... 7. *suadus* Cresson.

Stigma and costa dark brown ..... 8. *auratus* n. sp.

Mesonotum mostly black, with one or two pale spots, or sutures pale; mesepimera black, except sometimes lateral light spot; venter more or less infuscated; femora and coxæ black basally.

Mesepimera black ..... 9. *graminis* n. sp.

Mesepimera with lateral white spot ..... 10. *pleuricus* Norton.

Head black; orbits black or strongly infuscated; thorax and abdomen black except sometimes central area of venter.

Stigma and costa pale.

Head and thorax with long, dense pubescense; stigma narrow, acuminate; reddish spot on mesepimera ..... 11. *pubescens* n. sp.

Head and thorax not unusually pubescent; stigma robust; mesepimera black.

Femora and venter mostly pale; large, robust species. 12. *montivagus* n. sp.

Femora and venter black; small species. 13. *coloradensis* n. sp.

Stigma brown or black.

Labrum, angles of pronotum, and tegulæ pale.

Clypeus black; bases of femora infuscated .. 14. *robustus* n. sp.

Clypeus with pale tips; femora pale ..... 15. *clypeatus* n. sp.

Labrum, angles of pronotum, and tegulæ black. 16. *ater* McGillivray.

III. Sheath as above; head narrowing more or less back of compound eyes; usually slender, elongate, black species, with brown costa and stigma.

Sheath narrow, regularly rounded at tip; stigma acuminate; venter pale; pectus black ..... 17. *nigropectus* Cresson.

Sheath moderately robust, more or less obliquely truncate, tip obtusely pointed; stigma broad, not acuminate.

Tergum reddish yellow; head coarsely, rugosely punctured. 18. *punctulatus* n. sp.

Tergum black, except lateral rufous spot on segments 2 to 5. 19. *abdominalis* n. sp.

Tergum black.

Femora pale ..... 20. *hoodi* n. sp.

Anterior femora pale; hind infuscated at tip .... 21. *corniger* Norton.

Femora all more or less infuscated or black.

Anterior femora light basally; basal half posterior tibiæ white. 22. *subalbatus* Norton.

Anterior femora infuscated basally, paling apically; posterior tibiæ gradually infuscated, more strongly toward tip. 23. *palliventris* Cresson.

Males.

I. (No male representatives).

II. Head not narrowed back of compound eyes, usually expanding; antennæ slender, not or scarcely compressed, and nearly if not quite as long as the entire insect.

1. Black dorsally and ventrally.

Stigma and costa more or less infuscated.

Legs, except tibiæ and tarsi, black.

Mouth parts and orbits black ..... 5. *extensicornis* Norton.

Mouth parts and orbits pale ..... 6. *affinis* n. sp.

Legs, except bases of femora, yellow ..... 24. *tritici* n. sp.

Stigma and costa hyaline ..... 25. *apicalis* n. sp.

2. Venter and more or less of tergum pale.

Wings hyaline; stigma brown.

Head pale, except large spot on vertex ..... 8. *auratus* n. sp.

Head black ..... 4. *aurantiacus* n. sp.

Wings strongly infuscated; stigma and costa smoky .. 26. *infumatus* n. sp.

3. Head and thorax mostly yellow; abdomen black, except tip; stigma and costa hyaline ..... 27. *thoracicus* n. sp.

III. Head usually distinctly narrowed back of compound eyes, never expanding; antennæ usually shorter, stouter, and compressed.

1. Black, including all of venter.

Pronotum and tegulæ black; legs beyond base of femora yellow, infuscated ..... 28. *koebelei* n. sp.

Pronotum, tegulæ, and legs reddish yellow ..... 29. *occidentalis* n. sp.

2. Black; venter more or less pale.

Orbits pale, or head with black limited to spot about ocelli.

30. *carolinensis* n. sp.

Orbits black or strongly infuscated.

Clypeus deeply emarginate; triangle between antennæ and clypeus white; inner tooth of claw large ..... 31. *wrangeli* n. sp.

Clypeus deeply emarginate; triangle black; inner tooth of claw minute; stigma very narrow, tapering ..... 32. *minutus* n. sp.

Clypeus broadly emarginate, approaching truncate; triangle black; claws normal.

Clypeus black; venter infuscated laterally ..... 20. *hoodi* n. sp.

Clypeus with pale tips.

Legs pale, except extreme tips of posterior tibiæ and their tarsi.

22. *subalbatus* Norton.

Legs pale, except tips of hind femora above and apical third of hind tibiæ and the hind tarsi ..... 21. *corniger* Norton.

Legs reddish yellow; femora infuscated basally; abdomen usually entirely reddish yellow beneath.

33. *nevadensis* n. sp.

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1. Pachynematus dimmockii Cresson.

1880. *Nematus dimmockii* Cresson. Trans. Am. Ent. Soc., VIII, p. 6.

Female.—Length 8 mm.; exp. al. 18 mm.; rather robust, elongate, shining; clypeus deeply emarginate, lobes triangular, rounded, and with labrum clothed with long hairs; frontal crest and lateral walls of ocellar basin distinctly but not strongly elevated, former slightly broken at middle; antennal fovea shallow, indistinct; antennæ slender, as long as head and thorax, fourth joint much longer than third; second recurrent vein interstitial with second transverse cubital; outer veins of discal cells of hind wings interstitial; stigma rather broad, ovate or somewhat tapering; sheath very long, rounded at apex, projecting free one-half its length, blades thin and closely applied; cerci long, very slender, filiform; inner tooth of claw near apex rather broad. Color brownish black; abdomen lighter, inclined to fulvous; face below antennæ, upper and posterior orbits, pronotum, tegulæ, and legs except bases of coxæ, reddish yellow, strongly infuscated, particularly posterior tibiæ and all the tarsi; veins, including stigma, dark brown.

One female, Cresson's type. Collected by Mr. George Dimmock near the summit of Mount Washington, New Hampshire. (Coll. Am. Ent. Soc.)

2. Pachynematus ruralis Cresson.

1880. *Nematus ruralis* Cresson. Trans. Am. Ent. Soc., VIII, p. 5.

Female.—Length 8 mm.; head strongly developed back of compound eyes; clypeus angularly incised, lobes broad and rounded; ridges about anterior ocellus wanting; pentagonal area smooth, not depressed; antennal fovea sharply defined anteriorly; antennæ short, slender, joints 4 and 5 subequal and slightly longer than 3; intercostal vein nearly interstitial with basal; second cubital and second recurrent interstitial or nearly so, as also the outer veins of discal cells of hind wings; sheath very prominent, elongate, projecting free one-half its length, regularly tapering on both margins to rounded apex, blades thin, closely applied; cerci very slender, filiform; inner tooth of claw very minute. Color brownish black; orbits except narrow inner margins, face below base of antennæ, pronotum, tegulæ, abdomen beneath,

last dorsal segment, sheath, and legs yellowish white, with more or less brownish infuscation; bases of coxæ brown; femora and tips of tibiæ and tarsi brownish; wings slightly infuscated, nearly hyaline; veins, including stigma, brown.

One female, Cresson's type. Nevada. (Coll. Am. Ent. Soc.)

3. **Pachynematus ocreatus** Harrington.

1889. *Nematus ocreatus* Harrington. Can. Ent., xxi, p. 95.

Female.—Length 8.5 mm.; moderately robust; head expanding somewhat back of compound eyes; clypeus broadly, rather deeply emarginate, lobes rounded; ocellar basin with distinct and broad lateral walls; crest strong, unbroken; fovea shallow; antennæ slender, joints 3 and 4 subequal, fifth somewhat shorter; venation normal; sheath of ovipositor very long and large, projecting one-half its length beyond tip of abdomen, apex broadly rounded, blades thin, translucent, closely applied; cerci very long, slender; claws with minute inner tooth. Color shining resinous yellow; antennæ, spot on either side of lateral lobes of mesonotum, apex of scutellum, a few indeterminate marks on metanotum, and narrow border of basal plates brownish black; extreme tips of tibiæ brown; wings hyaline, stigma paler basally, costa yellow.

Redescribed from Harrington's type specimen. A specimen reared by Mr. Harrington from larva on spruce agrees very closely with this species, particularly in possessing the unusually developed sheath. In color the legs are a little more inclined to reddish and the hind tarsi and tip of sheath are distinctly infuscated. (Coll. Harrington.)

4. **Pachynematus aurantiacus** new species.

Female.—Length 9 mm.; robust; abdomen at middle much wider than thorax; head not narrowing back of compound eyes; clypeus distinctly but broadly incised, lobes broad, rounded; ocellar basin with sharply raised limiting walls; frontal crest sharp, unbroken; fovea deep, circular, distinctly limited; antennæ slender, about as long as head and thorax, tapering, third joint longer than fourth; venation normal, except that the second recurrent is sometimes interstitial or nearly so; stigma moderate, widest at middle, regularly rounded on lower margin; sheath broad, rather suddenly truncate near apex; cerci slender, not tapering; inner tooth of claw obtuse, remote from apex. Color orange yellow; inner orbits, head, above antennæ except upper and posterior orbits, broad stripe on the anterior and lateral lobes of mesonotum, apex of scutellum, postscutellum, spot on either side of cenchri, metascutum, center and sides of the basal plates, lower half of mesoepimera, corresponding sclerite of the metathorax together with spot on mesepisterna, black; extreme tips of posterior tibiæ and their tarsi infuscated; antennæ dark brown above, reddish ferruginous beneath; wings hyaline; veins, except costa, brown; stigma brown, costa yellow.

Male.—Length 6.5 mm.; structurally for the most part as in female; head not narrowing back of compound eyes; antennæ nearly as long as body of the insect, strongly tapering, robust, and somewhat compressed basally; procidentia broad, rounded, not projecting more than half its width, strongly keeled. Color black, shining; apex of clypeus, labrum, palpi, angles of pronotum, tegulæ, legs except bases of coxæ, venter, and most of tergum yellowish ferruginous; base of the dorsal segments, particularly of the first and second and fifth to seventh, brownish black; in some specimens all the segments are brownish black basally; tips of posterior tarsi and sometimes extreme tips of posterior tibiæ infuscated; antennæ reddish brown; wings hyaline, costal veins pale, stigma and veins otherwise brown.

Four females and five males. Montana. (Coll. Am. Ent. Soc.)

5. **Pachynematus extensicornis** Norton.

1861. *Nematus extensicornis* Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 159.
1864. *Nematus marylandicus* Norton Proc. Am. Ent. Soc. Phila., III, p. 7.
1867. *Nematus extensicornis* Norton. Trans. Am. Ent. Soc., I, p. 117. (Cat., etc., p. 59.)
1867. *Nematus marylandicus* Norton. Trans. Am. Ent. Soc., I, p. 197. (Cat., etc., p. 59.)
1867. *Nematus aureopectus* Norton. Trans. Am. Ent. Soc., I, p. 219. (Cat., etc., p. 81.)
1878. *Nematus extensicornis* Provancher. Nat. Can., X, p. 54.
1883. *Nematus extensicornis* Provancher. Add. Faun. Ent. Can. Hym., p. 185.
1891. *Nematus marylandicus* Riley and Marlatt. Insect Life, IV, p. 174, fig. 14.

Female.—Length 7 to 8.5 mm.; very robust species; abdomen particularly broad; head very much enlarged back of compound eyes; clypeus very shallowly excavated, lobes short, rounded; frontal crest and sides of ocellar basin strongly and distinctly defined, the former very minutely notched; antennal fovea extending laterally over bases of antennæ; antennæ moderately slender, tapering, joints distinctly defined, 1 and 2 equal; second recurrent vein interstitial with second transverse cubital; third cubital cell two and one-half times as long on lower margin as wide at base; discal cells of hind wings long, narrow, upper usually exceeding the lower; stigma rather broad, oval, not tapering more at apex than at base; sheath moderately broad and thick, obliquely truncate, upper edge nearly straight; cerci rather long, not tapering; claws with a very minute inner tooth, about $\frac{1}{4}$ of length of claw from apex. Color resinous or sulphur yellow; antennæ, small spot including ocelli, stripe on lateral lobes of mesonotum, spot on either side of and on base of scutellum, metanotum, tergum except narrow lateral margin and the two terminal segments, and sheath brownish black; bases of posterior coxæ, apices of their tibiæ and their tarsi, infuscated. There is ordinarily a faint trace of a black stripe on the middle lobe of the mesonotum, and in light specimens the black markings of the mesonotum are nearly obliterated, and the abdomen

is more or less banded with yellow on the posterior margin of the segments. The wing veins are light brownish for the most part; the costa and outer half of subcosta, the stigma, and the bases of most of the veins reaching the body of both fore and hind wings are nearly hyaline.

Male.—Length 6 to 7.5 mm.; rather slender, elongate, shining; structural details in general as in female; head not narrowed back of compound eyes; frontal crest is less distinctly raised and more distinctly notched; antennæ not compressed, almost as long as the body, and the nodes are distinctly enlarged, angular, clothed with distinct, rather short, black pubescence, third joint very robust and third to fifth subequal; procidentia very broad, slightly tapering and rounded at apex; hypopygium more or less excavated at tip. Color black; tips of femora, tibiæ, and hypopygium yellowish, infuscated; tarsi, cerci, and tips

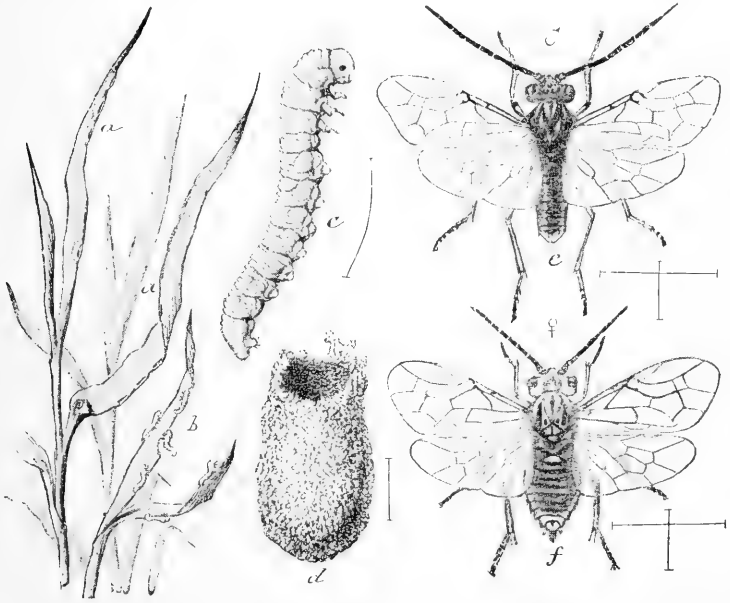

FIG. 9.—*Pachynematus extensicornis:* *a*, eggs in wheat; *b*, young larvæ; *c*, mature larva; *d*, cocoon; *e*, adult male; *f*, adult female; *a* and *b*, natural size; *c* to *f*, enlarged. (From Insect Life.)

of tibiæ more distinctly infuscated; posterior orbits tinged with fulvous; veins dark brown; stigma and costa yellowish brown, the former lighter at center.

Represented by many specimens of both sexes, some of them reared from larvæ taken on wheat in Indiana by Mr. Webster and others collected throughout the Northeastern United States. (Colls. U. S. Nat. Mus., Am. Ent. Soc., and Cornell Univ.)

6. Pachynematus affinis new species.

Female.—Length 5.5 to 6 mm.; very robust, shining; head greatly dilated back of eyes; clypeus very broadly and not deeply excavated,

lobes rounded; vertex roughened; lateral walls of ocellar basin irregular, not very distinctly raised; frontal crest rather sharply but not strongly developed, unbroken; antennal fovea shallow, extending widely over bases of antennæ; antennæ considerably longer than head and thorax, very slender, tapering, joint 4 as long as or longer than 3; second recurrent interstitial with second transverse cubital; upper discal cell of hind wings very slightly exceeding lower, venation otherwise normal; stigma broad, regularly rounded on lower margin; sheath rather narrow, tapering, straight on upper margin, obtusely pointed; cerci long, slender, filiform; inner tooth of claw minute, remote from apex. Color luteous; antennæ, small spot including ocelli, spot on lateral lobes of mesonotum, spot on either side and apex of scutellum, postscutellum and central region of metanotum, basal plates, tergum (except lateral margins and last two segments), and sheath black; apical margins of segments yellow in the lighter specimens; extreme apices of hind tibiæ, the hind tarsi, bases of posterior coxæ, and small spot beneath anterior wings infuscated; stigma, costa, upper edge of subcosta, and bases of all veins reaching the body hyaline; other veins brown.

Male.—Length 6 mm.; not very robust, shining, head expanding beyond compound eyes posteriorly; clypeus scarcely emarginate, nearly truncate; vertex roughened; walls about ocellar basin rounded, indistinct, basin narrowly excavated at center; antennal fovea circular, shallow, extending laterally over bases of antennæ; antennæ long, tapering, cylindrical, basal joints slightly compressed, joints nodose at tip, fourth longest; venation normal, except that the second recurrent and second transverse cubital and the outer veins of discal cells of hind wings are interstitial; stigma moderately broad, rounded beneath, tapering or acuminately pointed; procidentia projecting only about half its width, broadly truncate at apex; claws with minute inner tooth remote from apex. Color black; clypeus, mouth parts, upper and posterior orbits, apices of femora, the tibiæ and tarsi, and extreme apex of abdomen, particularly hypopygium, yellowish ferruginous, more or less infuscated, particularly at apices of posterior tibiæ and all of tarsi; veins brown; stigma and costa light brown.

Eight females and four males. Montana. (Coll. Am. Ent. Soc.)

7. Pachynematus suadus Cresson.

1880. *Nematus suadus* Cresson. Trans. Am. Ent. Soc., VIII, p. 10.
1886. *Nematus suadus* Provancher. Add. Faun. Can. Hym., p. 24.

Female.—Length 6.5 mm.; very short and robust; head strongly expanding posteriorly to compound eyes; clypeus broadly and shallowly excavated; frontal crest and sides of ocellar basin indistinct; vertex somewhat roughened; antennal fovea almost wanting; second recurrent interstitial with second transverse cubital; discal cells of hind wings of about equal length; third cubital cell but little more

than twice as long as wide at base, its upper and lower sides of equal length; stigma oval at base, rather acute at apex; sheath narrow and pointed at tip, upper edge straight; cerci prominent, not tapering; inner tooth of claw distinct. Color shining honey yellow; antennæ, narrow spot connecting ocelli, line on the anterior and lateral lobes of mesonotum, mesopostscutellum, metascutum, center of basal plates, and the bases of the first six dorsal segments black or fuscous; sheath reddish fuscous, almost black; tarsi infuscated, particularly posterior pair; wings infuscated; veins light yellowish brown; stigma and costa nearly hyaline.

Two females, labeled "F. B." and "N. H.," Cresson's types. (Coll. Am. Ent. Soc.)

8. **Pachynematus auratus** new species.

Female.—Length 8 mm.; very robust; abdomen very much wider than thorax, somewhat flattened; head strongly expanding back of eyes, shining; clypeus distinctly but shallowly and broadly emarginate, lobes rounded; vertex roughened; frontal crest and lateral walls about ocellar basin rounded, indistinct, basin scarcely excavated; antennal fovea deep, circular, with lateral channels branching out over bases of antennæ; antennæ but little longer than head and thorax, slender, tapering, joints 3 to 5 subequal; venation normal, except that the second recurrent vein is interstitial, or nearly so, with the second transverse cubital, and the outer veins of the discal cells of the posterior wings are nearly interstitial; stigma broad, regularly rounded beneath; sheath rather narrow, slightly excavated on upper margin, rather sharply pointed at apex; inner tooth of claw minute, remote from apex. Color orange yellow; antennæ, small spot on vertex including ocelli, central line on scutellum and basal half of same, central area of metanotum, tergum except narrow lateral margin, apex of sixth and all of terminal segments, extreme bases of posterior coxæ, and the outer margin of sheath black; tips of posterior tibiæ and their tarsi infuscated; veins, including stigma and costa, except basal third of latter, dark brown.

Male.—Length 6.5 mm.; much more slender than female, but less so than male of *marylandicus;* structurally much as in female; head not narrowing back of compound eyes; antennæ long, slender, not noticeably compressed; procidentia large, triangular, projecting, obtusely rounded at tip. Color black, shining; face below antennæ, posterior and upper orbits, pronotum, tegulæ, venter extending over dorsal edge, narrowly on basal segments and more broadly toward apical ones, legs entirely except bases of coxæ, yellowish ferruginous; extreme tips of posterior tibiæ, with tarsi, slightly infuscated; wings hyaline; veins colored as in female.

Four females and two males. Montana. (Coll. Am. Ent. Soc.)

This species is very closely allied to the last in general characteristics, but is easily distinguished from it, also from *extensicornis*, with

which it agrees more nearly in point of size. The three species together form a very closely allied group, and doubtless have similar habits.

9. **Pachynematus graminis** new species.

Female.—Length 6.5 mm.; head dilated back of eyes; clypeus emarginate, almost truncate; antennal fovea distinct and breaking slightly through the frontal crest, the latter extending indistinctly to the orbits; second recurrent interstitial with the second cubital cross nerve; venation otherwise normal; stigma evenly rounded on lower margin; sheath rather broad, somewhat acuminately pointed, with straight upper margin; cerci very slender. Color brownish black; head yellowish, except area about ocelli and bases of antennæ; pronotum, tegulæ, abdomen beneath, terminal dorsal arcs, and most of legs yellowish white; more or less of base of scutellum whitish; bases of coxæ, extreme bases of femora, apices of tibiæ and the tarsi brownish, or more or less strongly infuscated; wings clear; veins brownish; stigma and costa almost hyaline.

One female. Nevada. (Coll. Am. Ent. Soc.)

10. **Pachynematus pleuricus** Norton.

1867. *Nematus pleuricus* Norton. Trans. Am. Ent. Soc., 1, p. 208. (Cat., etc., p. 70.)

Female.—Length 6.5 mm; rather robust, shining; head dilated back of eyes; clypeus rather shallowly and broadly emarginate; walls about the ocellar basin broad and rounded, crest unbroken, fovea extending laterally over bases of antennæ; antennæ slender, filiform, joints 4 and 5 equal and longer than 3; sheath narrow, tapering, tip obtusely pointed; venation normal, except that the first cubital is nearly hyaline; claws with minute inner tooth. Color black and pallid or resinous; antennæ, spot on vortex including ocelli and reaching to bases of antennæ, large spot on each of the anterior lobes of mesonotum, apex of scutellum with spot on either side, metanotum, tergum except tip, mesepimera except large lateral spot, more or less of base of venter, bases of coxæ, trochanters, and bases of femora black; extreme tips of tibiæ, particularly hind pair, and tarsi strongly infuscated; sheath brown; except as noted, resinous yellow; wings hyaline; veins brown; stigma and costa hyaline.

Two females. Colorado, C. P. Gillette, collector (Coll. U. S. Nat. Mus.), and Idaho (Coll. Cornell Univ.). Norton's type specimens are lost.

11. **Pachynematus pubescens** new species.

Female.—Length 8 mm.; robust, shining; head dilated back of eyes; clypeus broadly, shallowly notched; ocellar basin rather indistinctly defined, crest low, unbroken; antennal fovea triangular; head very coarsely roughened with small elevations and, together with thorax, densely clothed with long whitish pubescence; antennæ slender, joints

4 and 5 subequal, longer than 3; sheath short, tapering, obtusely pointed; claws with minute inner tooth; venation normal, except that the second recurrent is interstitial with the second cubital; stigma very narrow and acuminate. Color black; tips of clypeus, mouth parts, extreme angles of pronotum, tegulæ, tip of abdomen except sheath, and outer half of femora reddish yellow; tibiæ pale yellowish; tarsi slightly infuscated; sides of mesepimera slightly reddish; wings hyaline, veins dark brown; costa and stigma hyaline.

Two females. Mount Washington, N. H. One labeled as having been taken at an elevation of about 6,000 feet, July 9, 1891. (Coll. Cornell Univ.)

12. **Pachynematus montivagus** new species.

Female.—Length 8 mm.; robust; head dilated back of eyes; head and thorax opaque from rather fine and dense puncturing, together with very short and inconspicuous pubescence; clypeus broadly and shallowly emarginate; pentagonal area distinctly defined, lateral walls sharp, minute; crest unbroken, not prominent; fovea oval; antennæ short, slender, tapering, joints 3 and 4 subequal; sheath short, tapering; claw with short inner tooth; venation normal, except that second recurrent is interstitial with second cubital; stigma broad, rounded beneath, scarcely tapering. Color black; labrum, angles of pronotum, tegulæ, extreme tip of abdomen, venter for the most part, and legs yellowish, inclined to reddish on femora; coxæ except tips and extreme bases of femora infuscated; tips of posterior tibiæ and their tarsi brownish; abdomen with brownish spots beneath, noticeably at base; wings hyaline, or nearly so; veins brown; stigma and costa light yellowish, almost hyaline.

One female. Mount Washington, N. H. (Coll. Cornell Univ.)

This species resembles the preceding in size and general characteristics, but diverges notably in the character of the stigma and pubescence of head and thorax.

13. **Pachynematus coloradensis** new species.

Female.—Length 6 mm.; moderately robust, shining; head dilated back of eyes; clypeus broadly, circularly emarginate; pentagonal area distinctly defined, but walls rounded; crest low, unbroken; fovea shallow, extending over bases of antennæ; antennæ slender, tapering, joint 4 slightly longer than 3; venation normal, except that the second recurrent is nearly interstitial with second cubital; stigma rounded, scarcely tapering; sheath obliquely tapering on lower margin, pointed; claws with minute inner tooth. Color black, shining; posterior orbits, mouth parts including tips of clypeus, angles of pronotum, tegulæ, tip of abdomen except sheath, outer third of femora, and the tibiæ and tarsi pallid more or less infuscated, particularly tarsi and orbits;

wings hyaline, or nearly so; veins light brown; stigma and costa pale, nearly hyaline.

One female. Colorado. C. P. Gillette, collector. (Coll. U. S. Nat. Mus.)

14. **Pachynematus robustus** new species.

Female.—Length 6 mm.; short, very stout; head dilated back of eyes; clypeus rather shallowly but distinctly emarginate; frontal crest well defined, unbroken; antennal fovea circular, deep; head very coarsely and rugosely punctured; antennæ very slender, elongate, joints 3 and 4 subequal; intercostal more than twice its length anterior to basal vein; second recurrent interstitial or nearly so with second cubital, venation otherwise normal; stigma large, widest near base; sheath robust, slightly acuminate toward apex; cerci long, filiform. Color black; labrum, angles of pronotum, tegulæ, more or less of the ventral segments of abdomen, the apex of the last dorsal segment, and legs for the most part light yellowish brown; coxæ basally strongly infuscated; femora, apices of tibiæ, and the tarsi dark brown; wings hyaline; veins and stigma brown; costa yellowish.

One female. Montana. (Coll. Am. Ent. Soc.)

15. **Pachynematus clypeatus** new species.

Female.—Length 6.5 mm.; somewhat elongate, shining; head rather coarsely punctured, widening noticeably back of compound eyes; clypeus not very deeply emarginate, lobes short, rounded; pentagonal area distinctly defined, walls not very sharply raised; fovea shallow; crest low, unbroken; antennæ rather slender, fourth joint a little longer than third; sheath tapering, somewhat obliquely truncate toward tip; venation normal, except that the second recurrent is interstitial with second cubital; stigma broad, rounded on lower margin; claws with minute inner tooth. Color black; small spot beneath bases of antennæ, tips of clypeus, labrum and other mouth parts, outer half of pronotum, tegulæ, legs, and venter of abdomen yellowish; posterior margins of dorsal segments, especially basal ones, pale, together with all of the terminal segment; bases of coxæ, extreme tips of posterior tibiæ, and the posterior tarsi brown; bases of femora slightly infuscated; sheath brown; wings nearly hyaline; veins and stigma light brownish; posterior orbits reddish, strongly infuscated.

Two females. Montana. (Coll. U. S. Nat. Mus.)

16. **Pachynematus ater** McGillivray.

1893. *Messa atra* McGillivray. Can. Ent., xxv, p. 238.

Female.—Length 6 mm.; robust, shining, somewhat duller on head from rather dense punctuation; head dilated back of eyes; clypeus very broadly and shallowly notched; ocellar basin distinctly limited, walls

rounded, crest slightly broken; fovea shallow (antennæ wanting); venation normal, except that the second recurrent is interstitial with the second cubital; stigma broad, rounded beneath, somewhat acuminately pointed; claws with minute inner tooth. Color black, including mouth parts, pronotum, and tegulæ; tips of coxæ, trochanters, tips of femora, the anterior tibiæ, and the tarsi pallid, strongly infuscated; veins, including costa and stigma, dark brown; wings nearly hyaline, slightly smoky.

One female, McGillivray's type. Olympia, Wash. Trevor Kincaid, collector. (Coll. Cornell Univ.)

17. **Pachynematus nigropectus** Cresson.

1880. *Nematus nigropectus* Cresson. Trans. Am. Ent. Soc., VIII, p. 6.

Female.—Length 8 mm.; moderately robust, glistening; clypeus very gently emarginate; frontal crest and lateral margins of ocellar basin distinctly but not strongly developed, former unbroken; antennal fovea deep, expanding broadly posteriorly; antennæ slender, filiform, joint 4 longest, 5 longer than 3; venation normal; stigma very broad, ovate, somewhat acuminate at apex; sheath narrow, regularly rounded at apex; cerci very narrow, not tapering; inner claw tooth rather large, sharp. Color for the most part luteous; face and upper and posterior orbits pallid; antennæ, vertex and occiput, prosternum, mesonotum, metanotum, broad stripe on dorsal sclerites of abdomen except last, basal half of mesepimera (pectus), and the metepisterna black; tip of sheath and tips of posterior tibiæ, the posterior tarsi, and the anterior tarsi to a less extent, infuscated; veins, including stigma and the costa nearly to base, brown; wings slightly infuscated, almost hyaline.

One female. Nevada. (Coll. Am. Ent. Soc.)

18. **Pachynematus punctulatus** new species.

Female.—Length 6.5 mm.; rather robust, head and thorax strongly punctured and somewhat opaque; clypeus, labrum, and pleuræ with rather long and dense yellowish hairs; clypeus shallowly emarginate, lobes broad and rounded; frontal crest and elevated ridges about anterior ocellus prominent, former unbroken; antennal fovea broad, oval; second recurrent interstitial or received in third cubital cell; second cubital cross vein two-thirds as long as third; upper middle cell of hind wings very little exceeding lower; stigma broad, rounded on lower margin, widest at center; sheath broad, truncate; cerci moderately slender, tapering; inner tooth of claw short, obtuse. Head and thorax for most part, basal plates, base of first dorsal segment, sheath, and extreme bases of coxæ brownish black; upper orbits and some marks on dorsum of thorax, including most of scutellum, reddish; triangle below antennæ, tips of clypeus, labrum, pronotum, tegulæ, legs, and abdomen including cerci reddish yellow; extreme tips of posterior tibiæ and the

posterior tarsi slightly infuscated; veins and stigma light brown; costa yellowish.

One female. New Hampshire. (Coll. Am. Ent. Soc.)

19. **Pachynematus abdominalis** new species.

Female.—Length, 6.5 mm.; robust, shining; head obscured by dense punctuation; clypeus nearly truncate, scarcely emarginate; ocellar basin indistinctly defined, lateral walls almost obsolete; frontal crest low; fovea oval (antennæ wanting); sheath short, obliquely truncate at apex; stigma regularly rounded beneath, not very broad; venation normal; claw with large, prominent inner tooth near apex. Color black; clypeus whitish; pronotum, tegulæ, and legs reddish yellow; tarsi brown; spot on either side of tergum, extending over segments 2 to 5, reddish yellow; venter of abdomen with yellowish central stripe and more or less yellow toward tip; tips of posterior tibiæ and the posterior tarsi infuscated; wings smoky; veins, including stigma, brown.

One female. Skokomish River, Washington, May 14, 1892, Trevor Kincaid, collector. (Coll. Cornell Univ.)

20. **Pachynematus hoodii** new species.

Female.—Length 6.5 mm.; very short, robust; clypeus shallowly and broadly emarginate; frontal crest strongly developed, unbroken; antennal fovea circular; antennæ long, slender, joints 3 and 4 subequal; venation normal; stigma broad, evenly rounded; sheath broad, obliquely truncate at apex; cerci rather robust; claw with minute inner tooth. Color black, shining; labrum, bases of mandibles, palpi, angles of pronotum, tegulæ, venter of abdomen, terminal dorsal segment, and the legs light yellowish; extreme bases of coxæ and the sheath dark brown, almost black; hind tarsi dark brown; wings slightly infuscated, almost hyaline; veins, including stigma and costa, dark brown.

Male.—Length 5 mm.; head narrowing back of compound eyes; antennæ very large and long, compressed; procidentia narrow, not strongly produced, rounded at apex. Color as in female, except that the light areas are inclined to yellowish brown, with the venter of the abdomen decidedly brownish.

One female and five males. Mount Hood, Oregon, and Washington. (Coll. Am. Ent. Soc.)

21. **Pachynematus corniger** Norton.

1861. *Nematus corniger* Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 159.
1867. *Nematus corniger* Norton. Trans. Am. Ent. Soc., I, p. 199. (Cat., etc., p. 61.)
1878. *Nematus corniger* Provancher. Nat. Can., I, p. 55.
1883. *Nematus corniger* Provancher. Faun. Ent. Can. Hym., p. 184

Female.—Length 6 to 7 mm.; moderately robust; clypeus shallowly incised, approaching truncate; vertex finely tuberculate; lateral walls

of ocellar basin very minutely but sharply raised, becoming obsolete posteriorly; frontal crest acutely elevated, angulated, and extending nearly to orbits; antennal fovea broad, extending laterally over bases of antennæ; antennæ long, slender, third joint longer than fourth; intercostal cross nerve nearly twice its length anterior to basal nerve, slightly inclined; second recurrent interstitial, or nearly so, with second transverse cubital; venation otherwise normal; stigma broad, regularly rounded beneath; sheath broad, straight on upper margin, obliquely truncate at apex, bordering hairs minute, scattering; cerci long, scarcely tapering; inner tooth of claw small, remote from apex. Color black, shining; apex of clypeus and other mouth parts, outer third of pronotum, tegulæ, anterior pairs of legs entirely, posterior pair except extreme bases of coxæ and apices of femora and of tibiæ and all of tarsi, venter of abdomen except overlapping sides of last dorsal segment and sheath, very narrow lateral margin of abdomen dorsally, and more or less of apex of all segments yellowish white; femora, particularly hind pairs, more or less inclined to reddish; stigma and veins, except base of costa and slightly at apex, brown.

Male.—Length 5 to 5.5 mm.; structurally for the most part as in female; antennæ very broad or strongly compressed, tapering; procidentia rounded at apex, not constricted basally, strongly keeled. Color black; tips of clypeus, mouth parts, angles of pronotum, tegulæ, venter of abdomen, and legs except extreme bases of coxæ and apices of posterior tibiæ and tarsi of same, yellowish ferruginous; venter of abdomen infuscated laterally, and sometimes more or less entirely.

Seven females and three males. Canada, New Jersey, New Hampshire, Pennsylvania, and Illinois (Coll. Am. Ent. Soc.), and Colorado (Coll. U. S. Nat. Mus.).

22. **Pachynematus subalbatus** Norton.

1864. *Nematus subalbatus* Norton. Proc. Ent. Soc. Phila., III, p. 7.
1867. *Nematus subalbatus* Norton. Trans. Am. Ent. Soc., I, p. 199. (Cat., etc., p. 61.)
1878. *Nematus subalbatus* Provancher. Nat. Can., X, p. 54.
1883. *Nematus subalbatus* Provancher. Faun. Ent. Can. Hym., p. 184.

Female.—Length 8 mm.; rather elongate; head densely and closely punctured or rugose; clypeus distinctly but not deeply emarginate, lobes rounded; frontal crest very strongly developed, very slightly broken at center, not reaching orbits; sides of ocellar basin distinct, but not strongly elevated; antennal fovea distinct, broadening posteriorly into a suture beneath frontal crest; antennæ longer than head and thorax, moderately robust, tapering, third joint longest; venation normal, except that second recurrent is interstitial, or nearly so, with second transverse cubital; stigma broad, scarcely tapering, until near apex; sheath rather broad, rounded, truncate at apex, straight on upper margin; cerci rather stout, tapering; inner tooth of claw minute,

remote from apex. Color black; tips of clypeus, labrum, angles of pronotum, tegulæ, coxæ except bases, trochanters, bases of femora and tips of anterior pairs, tibiæ except tips of posterior pair, anterior tarsi and venter except laterally at base and apex pallid; palpi fuscous; sheath and cerci black; stigma and veins dark brown, except base of costa, which is lighter.

Male.—Length 6.5 mm.; slender; head much narrowed back of compound eyes; structurally for the most part as in female; antennæ large and strongly compressed, tapering; procidentia short, narrow, truncate. Color black; tips of clypeus and mouth parts otherwise, angles of pronotum, venter and legs except extreme bases of coxæ, extreme tips of posterior tibiæ, and all posterior tarsi yellowish ferruginous; venter more or less infuscated laterally and apically (in a specimen from Michigan altogether dark fuscous).

Three females and two males. Massachusetts, Pennsylvania, and Michigan. (Colls. Am. Ent. Soc. and U. S. Nat. Mus.)

The reference of the males to this species is made with considerable doubt on general resemblance and correspondence in habitat.

23. **Pachynematus palliventris** Cresson.

1880. *Nematus palliventris* Cresson. Trans. Am. Ent. Soc., VIII, p. 5.
1894. *Nematus pallidiventralis* Dalla Torre. Cat. Hym., I, p. 248.

Female.—Length 6 mm.; moderately robust, shining; head as wide as thorax, quadrangular, vertex tuberculate; clypeus broadly and gently emarginate; frontal crest distinctly elevated, unbroken, extending nearly to orbits; sides of ocellar basin rounded, not strongly raised, indistinct; antennal fovea large, circular, deeply excavated; antennæ longer than head and thorax, rather slender, tapering, joint 3 longest; venation normal; stigma robust, broadest about middle; sheath rather slender, somewhat pointed at tip, dorsal margin nearly straight; cerci minute, filiform; inner tooth of claw minute, obtuse, remote from apex. Color black; labrum, bases of mandibles, angles of pronotum, tegulæ, coxæ except bases, trochanters, tibiæ of anterior pairs of legs and their tarsi, and venter of abdomen yellowish, inclined to pallid, especially on abdomen; femora brown, posterior ones darkest; posterior tibiæ and tarsi decidedly infuscated, especially tips of the tibiæ and the tarsi; more or less of the dorsal segments are narrowly yellow on the posterior margin and the lateral edges are yellow, also base of pygidium, including cerci; sheath black; wings hyaline; veins, including costa and stigma, brown.

One female, Cresson's type. Nevada. (Coll. Am. Ent. Soc.)

24. **Pachynematus tritici** new species.

Male.—Length 5.5 mm.; not very robust, head not narrowing back of compound eyes; clypeus rather deeply, somewhat angularly emargi-

nate, lobes broad, rounded; frontal crest and sides of ocellar basin not very strongly elevated, distinct; antennal fovea very shallow, broad; antennæ longer than head and thorax, rather robust and tapering, not compressed, joints 4 and 5 subequal, longer than 3; procidentia longer than broad, squarely truncate at apex; hypopygium strongly produced, rather narrow, and very slightly emarginate at apex; second recurrent interstitial or received at base of third cubital cell, which is scarcely or not twice as long as wide at base; outer veins of discal cells of hind wings interstitial, or nearly so; stigma broad at base, tapering roundly at apex. Color black, shining; triangular spot below antennæ, labrum, upper and posterior orbits, palpi, outer angles of pronotum, tegulæ, apex of abdomen, hypopygium and more or less of venter laterally, apices of coxæ, trochanters, femora except bases, tibiæ except apices, light fulvous; tips of tibiæ, the tarsi, veins, and stigma infuscated; costa yellowish on basal half.

One male, reared from a larva collected on wheat in Indiana by F. M. Webster; adult issued April 22. (Coll. U. S. Nat. Mus.)

25. **Pachynematus apicalis** new species.

Male.—Length 7 mm.; very slender, elongate, shining; head not narrowed back of compound eyes; clypeus very shallowly emarginate; walls about ocellar basin distinctly raised, rounded; antennal fovea circular; antennæ very long, slender, tapering, not compressed, fourth joint longest, all joints distinctly nodose at tip; procidentia broad at base, very long, tapering suddenly at tip, which is obtusely rounded; venation normal, except that the second recurrent is interstitial, or nearly so, with the second transverse cubital; outer veins of discal cells of hind wings are also nearly interstitial; stigma broad, widest near base, tapering regularly to apex; inner tooth of claw very minute, remote from apex of claw. Color black; tips of clypeus, labrum, upper and posterior orbits, angles of pronotum, tegulæ, apical half of femora, tibiæ and tarsi, and apical segments of abdomen yellowish ferruginous; stigma and costa and all veins reaching the body basally light yellowish, almost hyaline; other veins brown.

Two males. Montana. (Coll. Am. Ent. Soc.)

26. **Pachynematus infumatus** new species.

Male.—Length 8 mm.; robust, head not nearly as wide as thorax, not narrowing back of compound eyes; clypeus very slightly emarginate, almost truncate; vertex rugose; walls about ocellar basin indistinct; antennal fovea extending laterally over bases of antennæ, indistinctly defined; antennæ much longer than head and thorax, tapering, somewhat compressed basally; procidentia very broad, tapering, squarely truncate at apex, not keeled; venation normal; claws with minute inner tooth. Color black; labrum, upper and posterior orbits, outer angles of pronotum, tegulæ, outer two-thirds of femora, tibiæ and tarsi, abdomen

except base of first segment dorsally, yellowish ferruginous; the tarsi and the extreme apices of the posterior tibiæ, pronotum, and tegulæ are distinctly infuscated; veins yellowish brown, stigma and costa lighter, but distinctly infuscated; wings distinctly smoky, especially centrally; small spot in center of the median and of the second cubital cell.

One male. Agricultural College, Mich. (Coll. U. S. Nat. Mus.)

27. **Pachynematus thoracicus** new species.

Male.—Length 6 mm.; rather robust, head expanding back of compound eyes; antennæ slender, cylindrical, filiform, not compressed; clypeus broadly emarginate, lobes rather pointed; pentagonal ridges sharply raised; antennal fovea divaricating over bases of antennæ; second recurrent and second cubital and outer veins of discal cells of posterior wings interstitial; stigma broad; claws with very minute inner tooth; procidentia very broad, protruding, tapering to roundly truncated apex. Color luteous ferruginous; antennæ, triangular spot beneath, large spot on vertex extending nearly to base of antennæ and posteriorly to occiput, center of lateral lobes of mesonotum, small spot at apex of scutellum, central area of metanotum, including all of basal plates and the abdomen dorsally and ventrally except apex, black; thorax beneath and legs entirely yellowish ferruginous; wings hyaline; veins light brown; costa and stigma yellow, nearly hyaline.

One male. Montana. (Coll. Am. Ent. Soc.)

In characters of head and antennæ and notably also in colorational features this species agrees with remarkable closeness with the female of *affinis*, and departs just as widely in these particulars from the male of that species. There is a possibility, therefore, that it is a hermaphroditic form.

28. **Pachynematus koebelei** new species.

Male.—Length 6 mm.; slender, elongate; head not expanding back of compound eyes, or slightly narrowed; clypeus shallowly emarginate; vertex roughened with minute, dense tubercles; ocellar basin with indistinct limiting walls; frontal crest low and scarcely developed; antennal fovea circularly, deeply excavated; antennæ longer than head and thorax, tapering, strongly compressed, joints 3 and 4 subequal; procidentia narrow, protruding nearly twice its width, strongly keeled, rounded at apex; hypopygium very obtusely rounded at apex, short; claws with minute inner tooth remote from apex; venation normal; stigma moderately broad, widest at center. Color black, shining; apical half of femora, tibiæ, and tarsi reddish ferruginous, more or less infuscated, particularly extreme tips of posterior tibiæ and their tarsi; veins dark brown, almost black, including stigma and costa.

One male. Oregon. (Coll. U. S. Nat. Mus.)

29. **Pachynematus occidentalis** new species.

Male.—Length 6 mm.; rather slender, elongate; head slightly narrowing back of compound eyes; clypeus broadly and shallowly emarginate; antennæ short, stout, strongly compressed; crest rounded, unbroken; fovea deep, oblong, somewhat constricted medially; procidentia broad, rounded; venation normal, except that the third cubital cell is quite elongate, the sides but slightly divaricating; stigma robust; antennæ very broad, flattened, and not much longer than head and thorax. Color black, shining; extreme apex of clypeus, labrum, part of angles of pronotum, tegulæ, and legs light reddish brown; coxæ, except extreme tips, black; tips of posterior tarsi brownish; wings slightly infuscated; veins and stigma dark brown.

Two males. Washington. (Coll. Am. Ent. Soc.)

30. **Pachynematus carolinensis** new species.

Male.—Length 5 mm.; head much narrowed back of compound eyes; clypeus broadly, circularly emarginate, lobes triangular; ocellar basin with distinctly defined limiting ridges; frontal crest strong, unbroken; fovea oval, shallow; antennæ elongate, tapering, slightly compressed basally; procidentia narrow, produced, truncate at apex; third cubital cell very short, quadrate; outer cross veins of discal cells of hind wings interstitial; stigma regularly rounded on lower margin. Color black; orbits, face beneath antennæ, mouth parts, pronotum, tegulæ, large spot on upper half of mesepimera, venter, and legs yellowish resinous; posterior tarsi slightly infuscated; wings hyaline; veins, including stigma, brown.

Three males. North Carolina. (Coll. Am. Ent. Soc.)

31. **Pachynematus wrangeli** new species.

Male.—Length 6 mm.; rather slender; head distinctly narrowed back of compound eyes; clypeus rather deeply incised, lobes medium, rounded at apices; vertex shining; walls about ocellar basin distinctly but not strongly raised, rounded; frontal crest slightly broken; antennal fovea very distinct, clearly defined, circular; antennæ long, tapering, slightly compressed basally, fourth joint distinctly longer than third; upper discal cell of hind wings very slightly exceeding lower; procidentia scarcely projecting, nearly squarely truncate at apex, slightly constricted basally; hypopygium distinctly notched at tip; inner tooth of claw large, remote from apex. Color black, shining; triangular spot beneath antennæ, lower orbits, mouth parts, angles of pronotum, tegulæ, coxæ, trochanters, all of anterior legs, more or less of underside of posterior femora, and the venter yellowish white, more or less infuscated, giving a grayish aspect to the lighter-colored parts; veins, stigma, and costa to base dark brown.

Three males. Fort Wrangel, Alaska. Mr. H. F. Wickham, collector. (Coll. U. S. Nat. Mus.)

32. **Pachynematus minutus** new species.

Male.—Length 5 mm.; slender, head not much narrowed back of compound eyes; clypeus broadly emarginate, lobes small, triangular; ocellar basin with low but distinct lateral walls; crest low, slighty broken; fovea oval; antennæ rather long, slender, slightly compressed basally, joint 4 slightly longer than 3; venation normal; stigma very narrow, acuminate; claw with minute inner tooth not very remote from tip. Color black; tips of clypeus, labrum, tegulæ, last ventral segment of abdomen, and legs for the most part reddish yellow; coxæ and bases of femora black; wings slightly infuscated; veins brown; stigma scarcely paler.

Three males. Olympia, Wash., May 5–16, 1894–95. Trevor Kincaid, collector. (Coll. Cornell Univ.)

33. **Pachynematus nevadensis** new species.

Male.—Length 6 mm.; slender, elongate; head somewhat narrowed back of compound eyes; clypeus shallowly, broadly emarginate, lobes narrow, rather sharp pointed; ocellar basin distinctly defined, walls rounded; antennal fovea oval, not very distinctly defined; antennæ longer than head and thorax, strongly compressed, tapering, joints 3 to 5 subequal; venation normal; stigma moderately robust, widest at center; procidentia small, narrow, protruding, rounded at apex; claws with minute inner tooth not very remote from apex. Color black, shining; more or less of apex of clypeus, labrum and mouth parts, extreme angles of pronotum, tegulæ, legs except coxæ, venter, and more or less of apex of dorsal sclerites reddish ferruginous, somewhat infuscated, especially on bases of femora, trochanters, posterior tibiæ and their tarsi; posterior orbits narrowly and obscurely reddish; veins and stigma dark brown.

Five males. Nevada. (Coll. Am. Ent. Soc.)

XIV. Genus **MICRONEMATUS** Konow.

Micronematus Konow. Deutsche Entom. Zeitsch., XXXIV, 1890, p. 239.

Body small, ovate; clypeus emarginate at apex; claws with subapical tooth; pentagonal area obsolete; antennæ short, filiform; costal vein greatly dilated at apex, first transverse cubital nerve present; eighth (seventh ?) dorsal segment of male with short carina; sheaths of female simple.—Konow.

This genus seems to be of doubtful value and at least has no American representatives. The only one of the European species which I have had the opportunity of examining, *Micronematus pullus* Först., seems to belong to my new genus *Gymnonychus*.

XV. Genus LYGÆONEMATUS Konow.

Lygæonematus Konow. Deutsche Entomologische Zeitschrift, 1890, II, p. 238.

Body elongate-ovate; clypeus truncate at apex; pentagonal area more or less distinct; claws with short, subapical tooth; last dorsal segment of the male carinate, carina subproduced at apex; sheath of female simple.—Konow.

As already indicated under the preceding genus, the characters given in the descriptions of the genera *Pachynematus* and *Lygæonematus* by Konow are insufficient to satisfactorily separate the species. For this reason most of the American species have been referred to the first-named genus. I have, however, placed two species in the genus *Lygæonematus* which seem most typical in the characters supposedly peculiar to it. One of them, the European *L. erichsonii* Hartig, is also so referred by Konow. Almost all of the third group of species referred to *Pachynematus* could with equal propriety be placed in *Lygæonematus*. If it should seem later advisable to separate the material now referred to *Pachynematus* it could be best done, at least so far as the American species are concerned, on the basis of the characters indicated in the table of species separating groups 2 and 3, rather than on characters proposed by Konow. The two species referred to *Lygæonematus* may be roughly separated, as follows:

Abdomen black ..... 1. *winnipeg* Norton.
Abdomen, with four basal segments, orange yellow ..... 2. *erichsonii* Hartig.

1. Lygæonematus winnipeg Norton.

1867. *Nematus winnipeg* Norton. Trans. Am. Ent. Soc., I, p. 198. (Cat., etc., p. 60.)

Female.—Length 8 mm.; very robust; clypeus truncate; lateral ridges of ocellar basin low, indistinct, frontal crest wanting; fovea small, shallow (antennæ wanting); venation normal; stigma elongate, circular on lower margin; sheath broad, rounded at apex; cerci slender, tapering. Color black; head and thorax opaque; abdomen shining; clypeus in part, labrum, angles of pronotum, tegulæ, apex of abdomen dorsally and ventrally, apices of coxæ, trochanters, and legs for the most part yellowish ferruginous; anterior femora brown on lower margin, posterior femora with the brown extending over the sides, especially apically; extreme apices of posterior tibiæ and tarsi somewhat infuscated; veins, including costa nearly to base and stigma, brown.

One female, Cresson's type; a much-damaged specimen. Hudson Bay territory (Lake Winnipeg?). (Coll. Am. Ent. Soc.)

The males referred to in the original description have been lost.

2. Lygæonematus erichsonii Hartig.

1837.[1] *Nematus erichsonii* Hartig. Fam. Blatt. Holzwesp., p. 187.
1880. *Nematus notabilis* Cresson. Trans. Am. Ent. Soc., VIII, p. 7.

[1] Later European references are omitted.

1881. *Nematus erichsonii* Hagen. Can. Ent., XIII, p. 37.
1883. *Nematus erichsonii* Packard. Rept. U. S. Ent., pp. 138–146.
1883. *Nematus erichsonii* Packard. Bull. 3, Div. Ent., U. S. Dept. Agr., pp. 29, 30.
1883. *Nematus erichsonii* Fyles. Can. Ent., XV, p. 205.
1884. *Nematus erichsonii* Fletcher. Can. Ent., XVI, pp. 215, 216.
1884. *Nematus erichsonii* Packard. Am. Nat., XVIII, pp. 293–296.
1884. *Nematus erichsonii* Packard. Rept. U. S. Dept. Agric., p. 377.
1885. *Nematus erichsonii* Provancher. Add. Faun. Can. Hym., p. 5.
1885. *Nematus erichsonii* Provancher. Nat. Can., XV, pp. 38, 45–50.
1885. *Nematus erichsonii* Fletcher. Rept. Dept. Agric., Ottawa, Can., p. 28.
1886. *Nematus erichsonii* Harrington. Can. Ent., XVIII, p. 39.
1886. *Nematus erichsonii* Provancher. Nat. Can., XVI, p. 32.
1887. *Nematus erichsonii* Fletcher. Rept. Dept. Agric., Ottawa, Can., p. 35.
1888. *Nematus erichsonii* Lintner. Fifth Rept. Ins. N. Y., pp. 164–173.
1889. *Nematus erichsonii* Fletcher. Can. Ent., XXI, p. 152.
1890. *Nematus erichsonii* Packard. Fifth Rept. U. S. Ent. Comm., p. 879.
1890. *Lygæonematus erichsonii* Konow. Deutsch. Entom. Zeit., XXXIV, p. 247.

Female.—Length 11 mm.; exp. al. 22 mm.; large, moderately robust; head and thorax finely punctured, entire body shining; clypeus scarcely emarginate, almost truncate; frontal and lateral ridges of ocellar basin rounded, indistinct; vertex nearly smooth; antennal fovea long, shallow, deepest at apex; antennæ about as long as head and thorax, rather robust, tapering, joints 3 and 4 subequal; sheath broad, rounded, truncate at tip; cerci flattened, somewhat tapering; intercostal cross vein hyaline, indistinct, but anterior to basal and nearly at right angles to costa; first transverse cubital indistinct or wanting; stigma moderately broad, not acuminate; claw with minute inner tooth near apex. Color black; tip of clypeus, palpi, basal two-thirds of tibiæ, apices of trochanters, and extreme angles of pronotum whitish; femora, tips of anterior tibiæ and their tarsi, first four segments of abdomen above and beneath except base of first segment, orange rufous; extreme tips of middle femora above and hind femora a little more broadly, tips of hind tibiæ and their tarsi, black; lower surface of antennæ rufous; veins black, except costa, which is fulvous, and anal vein, which is whitish; wings somewhat infuscated; dusky spot in second cubital cell large, prominent.

Male.—Length 8.5 to 9 mm.; slender, elongate, abdomen not wider than thorax; in general, structurally as in female; procidentia strongly keeled, somewhat constricted basally, short, not projecting beyond the seventh dorsal segment; last ventral segment slightly emarginate at apex. Color black; antennæ, three basal segments of the abdomen dorsally except more or less of base of first segment, base of the fourth segment, all of venter of abdomen, and the legs except bases of coxæ reddish yellow; tips of the hind tibiæ and the hind tarsi brownish; face below antennæ, more or less of lower orbits, pronotum, and tegulæ whitish; wings as in female.

Male described from one and female from many reared specimens from Canada. (Coll. U. S. Nat. Mus.) Other females examined repre-

sent Labrador and Massachusetts—the latter Cresson's types of *notabilis*. (Coll. Am. Ent. Soc.)

XVI. Genus **PRISTIPHORA** Latreille.

Pristiphora Latreille, Fam. Nat. du Regne Animal, Paris, 1825.
Pristiphora Konow, Deutsche Ent. Zeits., XXXIV, 1890, p. 238.

Body short, ovate; clypeus truncate at apex; pentagonal area obsolete; claws either with subapical tooth or bifid; first transverse cubital of anterior wings often wanting or hyaline; eighth (seventh?) dorsal segment of the male carinate, carina not prominent at apex; sheath of female with rather dense scopa at tip.—Konow.

The species of this genus form a fairly well defined group, but are often referable rather from the sum of the characters than from any particular feature. The absence of the first cubital nerve is by no means constant, even in the same species, although usually a good generic character and to be relied upon. The claws are sometimes very evenly notched at the tips, but not deeply so. When this is the case, however, the smooth vertex, which is a very constant characteristic of the genus, taken in connection with the other characters, will usually determine the true affinities. Very little is known by actual rearings of the habits of the species, but in this particular they probably present no striking peculiarities. A number of them feed on willow and *P. idiota* Norton is an important enemy of the cranberry.

TABLE OF SPECIES.

Females

I. Head, thorax and abdomen black.
  Wings strongly infuscated ..... 1. *nigra* n. sp.
  Wings not or very slightly infuscated.
    Tegulæ black.
      Head small, narrow, not much more than one-half width of thorax.
        Posterior tibiæ and tarsi unicolorous, pale .. 2. *labradoris* Norton.
        Posterior tibiæ pale, tips black; tarsi black .. 3. *sycophanta* Walsh.
      Head broad, much more than one-half width of thorax.
        Posterior tibiæ strongly infuscated, nearly black . 4. *lata* Cresson.
        Posterior tibiæ pale except tips, which with tarsi are brown.
          5. *siskiyouensis* n. sp.
    Tegulæ pale.
      Labrum black; extreme tips only of hind tibiæ black.
        Stigma brown ..... 6. *murtfeldtiæ* n. sp.
        Stigma luteous, pale at base ..... 7. *relativa* Norton.
      Labrum, together with tip of clypeus, pale; apical half of hind tibiæ black ..... 8. *banksi* n. sp.

II. Head black; thorax and abdomen, or abdomen only, distinctly marked or banded with yellow.
  1. Pronotum black or only the extreme angle yellow; abdomen, with segments 2 to 5, yellow, sometimes interrupted centrally above ..... 9. *idiota* Norton.
  2. Pronotum, with outer one-half, yellow; femora yellow; segments 1 to 4 reddish yellow, infuscated ..... 10. *dyari* n. sp.

3. Pronotum as above; femora brown at tips or bases; segments 1 to 6 yellow.
   Stigma three times as long as wide; costa not or scarcely paler than stigma ..... 11. *jocularis* Cresson.
   Stigma twice as long as wide; costa much paler than stigma.
   12. *hoodi* n. sp.
4. Pronotum yellow; thorax otherwise black; abdomen black, except lateral third of segments after the first and venter ..... 13. *koebelei* n. sp.
5. Pronotum yellow; thorax and abdomen reddish yellow, marked with black.
   14. *bivittata* Norton.

Males.

Femora altogether black, or at least hind pair.
  Pronotum and tegulæ black.
    Posterior tibiæ pale, strongly infuscated at tips ..... 5. *siskiyouensis* n. sp.
    Posterior tibiæ strongly infuscated, nearly black ..... 4. *lata* Cresson.
  Pronotum black; tegulæ pale; apical half of hind tibiæ black . 8. *banksi* n. sp.
Femora black basally, paling apically; pronotum and clypeus black; labrum infuscated ..... 9. *idiota* Norton.
Femora pale, except sometimes tips of posterior pair.
  Abdomen, with basal segments, yellow ..... 11. *jocularis* Cresson.
  Abdomen altogether black dorsally.
    Venter pale ..... 15. *carolinensis* n. sp.
    Venter black.
      Pronotum and legs orange yellow ..... 16. *luteola* Norton.
      Pronotum and legs reddish yellow; genitalia strongly infuscated.
      17. *occidentalis* n. sp.
      Pronotum black, except extreme angles; legs and genitalia yellow.
      18. *coloradensis* n. sp.

INDEX TO SPECIES OF PRISTIPHORA.

banksi n. sp. ♂ ♀ 8
bivittata Norton ♀ 14
carolinensis n. sp. ♂ 15
coloradensis n. sp. ♂ 18
dyari n. sp. ♀ 10
hoodi n. sp. ♀ 12
idiota Norton ♂ ♀ 9
identidem Norton=idiota.
jocularis Cresson ♂ ♀ 11
koebelei n. sp. ♀ 13
labradoris Norton ♀ 2
lata Cresson ♂ ♀ 4
luteola Norton ♂ 16
murtfeldtiæ n. sp. ♀ 6
nigra n. sp. ♀ 1
occidentalis n. sp. ♂ 17
relativa Norton ♀ 7
siskiyouensis n. sp. ♂ ♀ 5
sycophanta Walsh ♀ 3
tibialis Norton=sycophanta.

1. Pristiphora nigra new species.

Female.—Length 5.5 mm.; surface somewhat shining, head rather densely and finely granulate; clypeus scarcely emarginate, almost truncate; elevations, frontal and ocellar, almost obsolete; antennal fovea broad, circular, shallow; intercostal cross vein about its own length anterior to basal and strongly inclined; first transverse cubital wanting, venation otherwise normal; stigma not greatly broadened at base; apex of costa considerably enlarged; scopa of sheath rather long and dense; cerci short tapering; inner tooth of claw short, obtuse. Color black; tibiæ, except apices of posterior pair and bases of tarsi, lighter, inclined to whitish; wings strongly infuscated; veins, including stigma and costa, dark brown.

One female. Easton, Wash. (Coll. U. S. Nat. Mus.)

2. **Pristiphora labradoris** Norton.

1867. *Nematus labradoris* Norton. Trans. Am. Ent. Soc., I, p. 196. (Cat., etc., p. 58.)
1878. *Nematus labradoris* Provancher. Nat. Can., X, p. 53.
1883. *Nematus labradoris* Provancher. Faun. Ent. Can. Hym., p. 185.

Female.—Length 5 mm.; short, robust; head and thorax densely granulate-punctate, with minute hoary pubescence; abdomen smooth, shining; head narrow, not more than half as wide as thorax, strongly trilobed when viewed from above; clypeus broadly but very shallowly emarginate, almost truncate; frontal crest and sides of ocellar basin indistinct, almost wanting; fovea indistinct; antennæ short, slender, scarcely tapering, third to fifth joints subequal; intercostal cross vein nearly twice its length anterior to basal vein, inclined; third cubital cell not much more than twice as long as wide at base, venation otherwise normal; stigma tapering regularly to somewhat acuminate apex from rather broadly ovate base; sheath tapering on both edges to rounded extremity, and with very distinct and heavy scopa; cerci strongly tapering; inner tooth of claw minute. Color black; margin of labrum, bases of mandibles and palpi, tibiæ and tarsi, apical half of anterior pair and extreme tips of two posterior pairs of femora, fulvous, more or less infuscated; veins light yellowish brown, including stigma and costa; wings hyaline, or but slightly infuscated.

One female, Norton's type (?). Labrador. (Coll. Am. Ent. Soc.)

3. **Pristiphora sycophanta** Walsh.

1866. *Pristiphora sycophanta* Walsh. Proc. Ent. Soc. Phil., VI, p. 263.
1867. *Pristiphora sycophanta* Norton. Trans. Am. Ent. Soc., I, p. 76. (Cat., etc., p. 46).
1867. *Pristiphora tibialis* Norton. Trans. Am. Ent. Soc., I, p. 76. (Cat., etc., p. 46).
1878. *Pristiphora tibialis* Provancher. Nat. Can., X, p. 50.
1881. *Pristiphora sycophanta* Packard. Bull. 7, U. S. Ent. Comm., p. 141.
1882. *Nematus sycophanta* Kirby. List Hym. Brit. Mus., I, p. 140.
1882. *Nematus trivialis* Kirby. List Hym. Brit. Mus., I, p. 140.
1883. *Pristiphora tibialis* Provancher. Faun. Ent. Can. Hym., p. 182.
1886. *Pristiphora sycophanta* Provancher. Add. Faun. Can. Hym., p. 22.
1890. *Pristiphora sycophanta* Packard. Fifth Rept. U. S. Ent. Comm., p. 598.
1894. *Nematus tibialis* Dalla Torre. Cat. Hym., I, p. 266.
1895. *Pristiphora sycophanta* Marlatt. Proc. Ent. Soc., Wash., III, p. 267.
1895. *Pristiphora tibialis* Dyar. Trans. Am. Ent. Soc., XXII, p. 301 (larva).

Female.—Length 5 mm.; moderately robust; head small, narrow, not much more than half the width of thorax; clypeus nearly truncate; vertex smooth, ridges rounded, subobsolete; fovea very minute, circular; antennæ slender, slightly tapering, third joint much longer than fourth; claw with very minute inner tooth; venation normal, except that the second cubital is wanting. Color black, shining, including mouth parts and tegulæ; anterior and middle tibiæ and tarsi yellowish; posterior tibiæ, except apical third, whitish; wings nearly hyaline; veins and stigma brown.

One female. Nevada. (Coll. U. S. Nat. Mus.) A specimen from Ithaca, N. Y., has also been referred, doubtfully, to this species.

Mr. H. G. Dyar reared this insect from green larvæ found on white birch (*Betula papyrifera*) at Keene Valley, N. Y., and also on willow and yellow birch at Jefferson, N. Y.

4. **Pristiphora lata** Cresson.

1880. *Nematus latus* Cresson. Trans. Am. Ent. Soc., VIII. p. 4.

Female.—Length 5.5 mm.; short, very robust; head nearly as wide as thorax, not noticeably trilobed, finely granulate; body generally clothed with fine hoary pile; clypeus truncate; frontal crest and sides of ocellar basin entirely wanting; antennal fovea very minute, shallow, circular; antennæ short, not longer than head and thorax, somewhat compressed, tapering, third and fourth joints subequal; intercostal cross nerve nearly interstitial with basal, inclined; third cubital cell not more than twice as long as wide at base; venation otherwise normal; sheath not very robust, tapering on both edges, with distinct scopa; cerci minute, not tapering; inner tooth of claw very minute. Color black; head and thorax opaque, abdomen shining; clypeus, apical two-thirds of first pair of femora and their tibiæ, and tarsi fulvous, inclined to fuscous; posterior tibiæ and tarsi fuscous; wings hyaline; veins dark brown; extreme angle of pronotum fulvous.

Male.—Characters in general as in the female. Color the same, except that the female sometimes has the extreme tip of the pronotum yellow; antennæ robust, short, strongly compressed; first cubital cross vein hyaline. Easily distinguished from all other males of the genus by the black pronotum and tegulæ, and black or strongly infuscated hind tibiæ.

Two females and one male. Nevada. (Colls. Am. Ent. Soc. and U. S. Nat. Mus.)

This species is very closely allied to *labradoris*, but differs particularly in the much wider head relative to the thorax, and also in minor details.

5. **Pristiphora siskiyouensis** new species.

Female.—Length 5 mm.; rather robust; head large, nearly as wide as thorax; vertex smooth, shining, with no indications of ridges; clypeus nearly truncate; antennal fovea wanting, or nearly so; antennæ slender, slightly tapering, third joint much longer than fourth; claw with minute inner tooth; venation normal, except that second cubital is wanting. Color black, shining, including mouth parts and tegulæ; anterior tibiæ and tarsi pallid, the tarsi slightly infuscated; posterior tibiæ white, except tips, which, with posterior tarsi, are brownish, almost black; wings hyaline; veins and stigma brown.

Male.—Agrees with female in colorational characters; antennæ stouter and somewhat compressed, distinctly tapering; easily distinguished by the black pronotum and tegulæ from other species, except

the closely allied *lata*, from which it may be separated by the characters of the hind tibiæ.

Two males and one female. Siskiyou County, Cal. April. Mr. Albert Koebele, collector. (Coll. U. S. Nat. Mus.)

This species is closely related in general appearance to *sycophanta* Walsh, but differs distinctly in shape and size of head relative to thorax.

6. **Pristiphora murtfeldtiæ** new species.

Female.—Length 6 mm.; not very robust, shining; head and thorax very finely punctured; clypeus truncate; antennal fovea shallow, indistinct, merging into the smooth ocellar region; antennæ moderately stout, joint 3 longest; intercostal vein more than its length anterior to basal; third cubital cell not more than twice as long as wide at base; inner tooth of claw obtuse, rather large. Color black; tegulæ, trochanters, tips of anterior femora, all tibiæ except tips of posterior pair, anterior pairs of tarsi and bases of posterior pair, fulvous.

One female, reared by Miss Mary Murtfeldt, at Kirkwood, Mo., from a smooth, greenish slug with black head, found feeding on black willow. Adult issued April 10, 1887. (Coll. U. S. Nat. Mus.)

7. **Pristiphora relativa** Norton.

1867. *Pristiphora relativus* Norton. Trans. Am. Ent. Soc., I, p. 77. (Cat. etc., p. 47.)

1882. *Nematus relativus* Kirby. List Hym. Brit. Mus., I, p. 140.

Female.—Length 0.18, br. wings 0.38 inch. Color shining black. Antennæ as in *P. tibialis*. Head coriaceous, without sensible depressions about the ocelli; edge of nasus incurved. Tegulæ and legs whitish; coxæ and a wide band on the femora black; tips of posterior tibiæ and their tarsi, except basal joint, fuscous. Wings hyaline, stigma and costa luteous, the latter pale at base; second submarginal cell contracted at junction with third cell.

Great Slave Lake, H. B. T. R. Kennicott, collector.

This is not as stout as the preceding species (*tibialis*), but resembles it much.

I have not examined the type of this species, and merely reproduce the original description.

8. **Pristiphora banksi** new species.

Female.—Length 5 mm.; rather robust; head nearly as wide as thorax; clypeus rounded in front, not at all emarginate; vertex without ridges around ocellar basin, deeply and coarsely punctured; antennæ tapering, third joint longest; claws with minute inner tooth; venation normal, except that second recurrent is wanting. Color black, shining; apex of clypeus, labrum, tegulæ, apices of coxæ, trochanters, and tibiæ for the most part pallid; anterior tarsi slightly infuscated; apical half of posterior tibiæ and the posterior tarsi black.

Male.—Agrees for the most part in structural and colorational char-

acters with the female. Antennæ are stouter and somewhat compressed. Differs from the female in that the pronotum is entirely black.

One male and one female. Sea Cliff, Long Island, and Ithaca, N. Y. Mr. Nathan Banks, collector. (Coll. U. S. Nat. Mus.)

9. Pristiphora idiota Norton.

1867. *Pristiphora idiota* Norton. Trans. Am. Ent. Soc., I, p. 77.
1867. *Pristiphora identidem* Norton. Trans. Am. Ent. Soc., I, p. 77. (Cat., etc., p. 47.)
1869. *Pristiphora identidem* Glover. Rept. U. S. Dept. Agr., p. 207.
1870. *Pristiphora identidem* Packard. Guide to Study of Insects, p. 217.
1872. *Pristiphora identidem* Norton. Trans. Am. Ent. Soc., IV, p. 78.
1877. *Pristiphora identidem* Glover. Rept. U. S. Dept. Agric., p. 92.
1878. *Pristiphora idiota* Provancher. Nat. Can., X, p. 50.
1881. *Pristiphora identidem* Thomas. 10th Rept. State Ent. Ill., 1880, p. 69.
1882. *Nematus idiotus* Kirby. List Hym. Brit. Mus., I, p. 140.
1883. *Pristiphora idiota* Provancher. Faun. Ent. Can. Hym., p. 182.
1883. *Pristiphora identidem* Saunders. Ins. Inj. to Fruits, p. 373.

Female.—Length 5 mm.; moderately robust; head with coarse, deep puncturing; ridges on either side of anterior ocellus rounded, nearly obsolete; clypeus nearly truncate; antennæ slender, third joint very much longer than fourth, fourth and fifth subequal; sheath rather slender, rounded at tip, with dense bordering fringe of hairs; claws with minute inner tooth; venation normal, except that the first cubital cross vein is wanting. Color black, shining; clypeus and palpi, tegulæ, and central area of abdomen, latter more or less interrupted dorsally, yellow; legs yellow; femora usually brown basally and apically, especially on upper and lower margins, or brown with sides reddish yellow; tips of posterior tibiæ and tarsi brown; wings hyaline; veins brown.

Male.—Agrees with female in structural and colorational characters, except that the abdomen is entirely black. Antennæ are considerably stouter than those of the female, cylindrical, not at all compressed.

Many specimens of both sexes. New Hampshire. (Colls. Am. Ent. Soc. and U. S. Nat. Mus.)

10. Pristiphora dyari new species.

Female.—Length 5.5 mm.; very robust; head with coarse, dense puncturing; frontal ridge slightly elevated; fovea shallow; clypeus nearly squarely truncate; antennæ tapering, third joint longest; sheath not very broad, rounded at apex, with dense bordering hairs; claws minutely cleft, sharp, inner tooth near apex; venation normal, except that first cubital is wanting. Color black, shining; clypeus, outer half of pronotum, tegulæ, segments 1 to 4 of abdomen, and legs reddish yellow; apical third of posterior tibiæ and their tarsi black; wings hyaline; veins dark brown.

One female. Keene Valley, N. Y., June 21, 1894. (Coll. Dyar.)

11. Pristiphora jocularis Cresson.

1880. *Pristiphora jocularis* Cresson. Trans. Am. Ent. Soc., VIII, p. 3.
1882. *Nematus jocularis* Kirby. List Hym. Brit. Mus., I, p. 141.

Female.—Length 7 mm.; robust; head coarsely punctured; vertex with ridges about anterior ocellus present, but rounded and indistinct; antennal fovea circular, shallow; clypeus squarely truncate, and with labrum clothed with rather dense and long, whitish hairs; sheath stout, with rather dense hairs; first cubital wanting; stigma three times as long as wide; claw tooth small and near apex, approaching bifid. Color black, shining, subsericeous; labrum and tip of clypeus pallid; outer half of angles of pronotum, tegulæ, abdomen except two apical segments, and legs for most part yellow; extreme bases of coxæ black; tips of posterior femora, tips of posterior tibiæ and their tarsi, brownish black; wings nearly hyaline; veins, including stigma and costa, dark brown.

Male.—Length 5 mm.; structurally as in female, except that the ridges of vertex are practically obsolete; fovea very shallow, almost wanting; antennæ compressed, tapering; procidentia short, keeled, constricted basally. Color as in female, except that the abdomen is black above, banded with yellow on second and third segments; posterior femora brown only at extreme tips above.

Cresson's type specimens, one male and one female. Morrison, collector. Nevada. (Coll. Am. Ent. Soc.)

12. **Pristiphora hoodi** new species.

Female.—Length 7 mm.; robust; head coarsely punctured; vertex, with ridges about anterior ocellus, rounded, subobsolete; antennal fovea circular, distinctly excavated anteriorly; clypeus squarely truncate; sheath broad, thickly clothed with hairs toward apex; claws with minute inner tooth near apex; first cubital wanting; stigma about twice as long as wide. Color black, shining, subsericeous; tip of clypeus and labrum whitish; outer half of angles of pronotum, tegulæ, abdomen except three terminal segments, and legs for the most part reddish yellow; outer half of posterior femora brown, anterior femora slightly infuscated basally; tips of posterior tibiæ and their tarsi infuscated; basal half of coxæ black; basal plates tinged with rufous; wings hyaline; veins brown, costa somewhat paler; first cubital cross vein hyaline.

One female. Mount Hood, Oreg. (Coll. Am. Ent. Soc.)

This species comes very close to Cresson's *jocularis*, but differs, perhaps, sufficiently to warrant a new species.

13. **Pristiphora koebelei** new species.

Female.—Length 6 mm.; robust; head coarsely and rugosely roughened with little tubercles; lateral ridges about anterior ocellus obsolete;

frontal crest moderately developed, obtuse; fovea shallow, clypeus truncate; antennæ moderately stout, scarcely tapering until near tip, third joint not, or scarcely, longer than fourth; venation normal, except that the first cubital is hyaline; sheath with dense fringe of hairs; claws, with rather large inner tooth, approaching bifid. Color black, shining; apex of clypeus, labrum, pronotum, tegulæ, abdomen, and legs for the most part reddish yellow; basal segment of abdomen, narrow line down center of dorsum of following segments, more or less interrupted at sutures, black; posterior tarsi and extreme tips of posterior tibiæ black; bases of all coxæ black; band on mesonotum, just above scutellum, rufous; wings hyaline, or nearly so; veins and stigma dark brown; spot in second cubital cell large and prominent.

Four females. Washington. (Colls. U. S. Nat. Mus. and Am. Ent. Soc.)

14. **Pristiphora bivittata** Norton.

1861. *Nematus bivittatus* Norton. Proc. Boston Soc. Nat. Hist., VIII., p. 158.
1867. *Nematus bivittatus* Norton. Trans. Am. Ent. Soc., I, p. 219. (Cat., etc., p. 81.)
1878. *Nematus birittatus* Provancher. Nat. Can., X, p. 56.
1883. *Nematus bivittatus* Provancher. Faun. Ent. Can. Hym., p. 188.

Female.—Length 6.5 mm.; robust, shining; head densely and finely tuberculate-granulate, opaque, clothed with sericeous hairs; clypeus nearly squarely truncate; ocellar and frontal ridges almost wanting; antennal fovea shallow, tapering anteriorly, indistinct; antennæ very robust, last four joints tapering somewhat suddenly, third to fifth joints subequal, more robust; sheath not very broad, obtusely pointed, scopa not very long but dense; cerci short, tapering; claws with rather long inner tooth; intercostal anterior to basal and almost at right angles with costa; wings otherwise normal; first transverse cubital wanting; stigma ovate at base, tapering regularly to apex. Color in general reddish orange; clypeus, labrum, bases of mandibles, inclined to pallid; head above clypeus and antennæ, stripe on lateral lobes of mesonotum and sometimes on anterior lobe, scutellum, metanotum, lateral dorsal angle of first segment, narrow stripe along center of dorsum, terminating on next to last segment, lower third of mesepimera, and sheath black or dark brown; tips of hind tibiæ and the hind tarsi strongly infuscated; veins, including stigma and costa nearly to base, dark brown; first transverse cubital hyaline, indistinct.

Four females. Canada, Massachusetts, and Illinois. (Coll. Am. Ent. Soc.)

15. **Pristiphora carolinensis** new species.

Male.—Length 5 mm.; rather slender; vertex without prominent ridges about anterior ocellus, somewhat roughened, with minute tubercles; frontal crest obsolete, fovea very shallow or nearly wanting; clypeus nearly truncate or very broadly and shallowly emarginate;

antennæ slender, elongate, joints slightly enlarged at tips; second cubital hyaline; outer veins of discal cells of hind wings interstitial; procidentia broad, strongly keeled; claws with minute inner tooth remote from apex. Color black, shining; clypeus, mouth parts, pronotum, tegulæ, legs, central area of abdomen ventrally, pale yellowish; apical half of posterior tibiæ and their tarsi brownish black; wings hyaline; veins light brown.

Three males, two without locality labels and one collected in North Carolina. (Coll. Am. Ent. Soc.)

16. Pristiphora luteola Norton.

1867. *Nematus luteolus* Norton. Trans. Am. Ent. Soc., I, p. 200. (Cat., etc., p. 62.)
1878. *Nematus luteolus* Provancher. Nat. Can., X, p. 55.
1883. *Nematus luteolus* Provancher. Faun. Ent. Can. Hym., p. 185.
1893. *Nematus luteolus* McGillivray. Can. Ent., XXV, p. 238.

Male.—Length 6 mm.; rather slender, elongate, shining; head and thorax strongly punctured; clypeus squarely truncate; ocellar and frontal ridges subobsolete; antennal fovea very shallow, broad; antennæ very robust, flattened, tapering, longer than head and thorax, joints 3 to 5 subequal; venation normal, except that intercostal vein is nearly at right angles to costa and the first transverse cubital is subobsolete or hyaline; upper discoidal cell of hind wings sometimes extending more than ⅛ its length beyond the lower cell; procidentia very broad, slightly excavated at tip, not projecting; hypopygium distinctly notched at tip; claws with rather large, prominent inner tooth. Color black; clypeus, labrum, bases of mandibles, palpi, legs for the most part, pronotum, and tegulæ yellowish ferruginous; tips of posterior tibiæ and tarsi fuscous; veins, including costa and stigma, except base of latter, brown.

Two males. Illinois and Massachusetts. (Coll. Am. Ent. Soc.)

17. Pristiphora occidentalis new species.

Male.—Length 5 mm.; not very robust; head roughened; lateral walls about anterior ocellus entirely wanting; crest present, rounded; fovea shallow; clypeus truncate; antennæ tapering, compressed basally; procidentia broad, not projecting beyond seventh segment; claws with minute inner tooth near apex; second cubital cross vein present; third cubital cell quadrate. Color black, shining; clypeus yellowish; pronotum, tegulæ, and legs reddish yellow; posterior tarsi infuscated; wings slightly smoky; veins and stigma dark brown; costa yellowish; genitalia strongly infuscated, nearly black.

Three males. Oregon and Washington. (Coll. U. S. Nat. Mus.)

18. Pristiphora coloradensis new species.

Male.—Length 5 mm.; not very robust; head roughened with minute tubercles; ridges about anterior ocellus wanting; crest indistinctly

raised; fovea shallow; clypeus truncate; antennæ stout, tapering, fourth joint longer than third; first transverse cubital wanting; claws with minute inner tooth. Color black, shining; distinct pubescence on pleura; apex of clypeus, labrum, extreme angles of pronotum, tegulæ, and legs for the most part yellow; coxæ black basally; posterior tibiæ at tips and their tarsi infuscated; wings hyaline; veins light brown; genitalia yellow.

One male. Colorado. (Coll. Am. Ent. Soc.)

XVII. Genus **GYMNONYCHUS** nov. gen.

[From γυμνός, naked, and ὄνυξ, claw.]

Body short, ovate; antennæ short, filiform, third joint longest; venation of *Pristiphora*, second cubital with both recurrent nervures; lanceolate cell petiolate; stigma ovate; tip of clypeus more or less emarginate; pentagonal area of vertex indistinctly outlined or wanting; claws simple, without inner tooth; sheath of female simple, obtusely pointed at tip.

This genus is separated from the preceding, *Pristiphora*, by the possession of a simple claw, without inner branch or tooth. The type of the genus is the species designated as *californicus*. Examination of the species of *Pristiphora* indicates also that *appendiculatus* Hartig (=*grossulariæ* Walsh) falls in this genus. These two species are very important ones economically, the latter being a well-known enemy of the gooseberry and the former reported to be a very serious enemy to the pear in various localities in California.

TABLE OF SPECIES.

Very short, robust; angles of pronotum broadly yellow.
- Clypeus and labrum black ..... 1. *californicus* n. sp.
- Clypeus and labrum pale ..... 2. *proximatus* Norton.

Somewhat less robust; pronotum unicolorous.
- Color black ..... 3. *appendiculatus* Hartig.
- Color resinous, inclined to reddish ..... 4. *resinicolor* n. sp.

1. Gymnonychus californicus new species.

Female.—Length 4.5 mm.; very short and robust, shining; head densely punctured, rather opaque; clypeus very slightly emarginate; frontal crest wanting or very slightly indicated; antennæ very short, not as long as head and thorax, filiform, third joint longest; intercostal nearly at right angles with costa, interstitial with basal; venation otherwise normal; stigma short, broad, ovate at base; apex of costa strongly thickened; sheath broad, slightly emarginate beneath and acuminate at tip; claws simple. Color black; angles of pronotum, tegulæ, trochanters, apices of femora (particularly anterior pair), tibiæ, and tarsi yellowish ferruginous; the posterior tibiæ and tarsi particularly somewhat infuscated; veins, including stigma and costa, dark brown; wings hyaline.

Eleven females, one collected at Brockport, N. Y., the others bred from larvæ found on pear trees near Sacramento, Cal., the adults issuing in March. (Coll. U. S. Nat. Mus.)

This sawfly was reported by Matthew Cooke to be very injurious in 1881–82 about Sacramento, Cal., and in adjoining counties. It feeds on the leaves of pear trees, skeletonizing them more or less, somewhat after the manner of the common cherry and pear slug. It forms little brown cocoons about the base of the tree, in which the larvæ hibernate, the adults issuing early in March. A second brood, apparently, was obtained in the latter part of April, indicating the probable occurrence of several annual broods. Mr. Koebele also sent specimens of this sawfly from Natoma, Cal., reporting it to be most destructive to pear trees in that region. He also noticed the same species ovipositing on pear trees at Santa Clara. If disturbed, the parent insect falls to the ground and remains

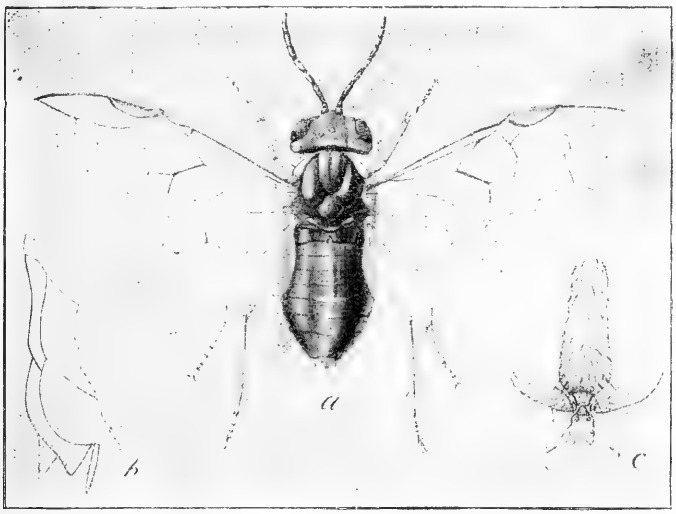

FIG. 10.—*Gymnonychus californicus: a*, female; *b*, lateral view of tip of abdomen, showing sheath and cercus; *c*, claw and pulvillus—all enlarged (original).

motionless for a time, with the antennæ and legs bent closely to the body. The characteristic features of the adult insect are indicated in the accompanying figure (fig. 10). It is probable that this is the undetermined pear sawfly referred to by Dr. J. A. Lintner as being very injurious in the Hammond nurseries, Geneva, N. Y., May 29, 1894. (2nd Rept. N. Y. State Entom., 1885, p. 5.)

2. **Gymnonychus proximatus** Norton.

1861. *Nematus proximatus* Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 160.
1867. *Nematus proximatus* Norton. Trans. Am. Ent. Soc., I, p. 202. (Cat., etc., p. 64).
1878. *Nematus proximatus* Provancher. Nat. Can., X, p. 55.
1883. *Nematus proximatus* Provancher. Faun. Ent. Can. Hym., p. 185.

Male.—Length 5.5 mm.; rather slender, shining; head and thorax punctured; clypeus squarely truncate; crest of head rounded, almost

wanting; antennal fovea indistinct or wanting, at most very shallow; antennæ not very robust, flattened, tapering, joints 3 to 5 subequal; venation normal; stigma not very robust, tapering; procidentia very broad, obtuse, strongly keeled; hypopygium broad, rounded at apex; claws without inner tooth. Color black; clypeus, labrum, and mouth parts pallid; angles of pronotum, tegulæ, more or less of apical half of femora, the anterior tibiæ and tarsi, and the basal two-thirds of tibiæ yellowish; more or less of bases of femora, especially of hind pair and apices of hind tibiæ and tarsi, and the tips of anterior tarsi brownish black; veins, including stigma and costa, the latter nearly to base, dark brown.

One male. Canada. (Coll. Am. Ent. Soc.)

3. **Gymnonychus appendiculatus** Hartig.

1823. *Pristiphora pallipes* Lepeletier. Mongr. Tenth., p. 60.
1835. *Nematus flavipes* Dahlbom. Conspect. Tenth. Scan., p. 9.
1837. *Nematus appendiculatus* Hartig. Fam. Blat. Holtz., p. 202.
1866. *Pristiphora grossulariæ* Walsh. Pract. Ent., I, pp. 117–125.
1866. *Pristiphora grossulariæ* Walsh. Pract. Ent., II, pp. 20, 33.
1867. *Pristiphora grossulariæ* Norton. Trans. Am. Ent., Soc. I, p. 77.
1867. *Pristiphora grossulariæ* Walsh. Pract. Ent., II, p. 121.
1868. *Pristiphora rufipes* Fitch. 12th Rept. Ins. N. Y., p. 908.
1869. *Pristiphora grossulariæ* Walsh and Riley. Am. Ent., II, pp. 12–22.
1870. *Pristiphora grossulariæ* Packard. Guide to Study of Ins., p 217.
1870. *Pristiphora grossulariæ* Glover. Rept. U. S. Dept. Agr., p. 77.
1875. *Pristiphora grossulariæ* Glover. Rept. U. S. Dept. Agr., p. 118.
1877. *Pristiphora grossulariæ* Riley. 9th Rept. Ins. Mo., pp. 23–26.
1877. *Pristiphora grossulariæ* Packard. 9th Rept. U. S. Geol. and Geog. Surv., 1875, p. 787.
1877. *Pristiphora grossulariæ* Glover. Rept. U. S. Dept. Agr., p. 92.
1878. *Pristiphora grossulariæ* Provancher. Nat. Can., X, p. 56.
1880. *Pristiphora grossulariæ* Provancher. Nat. Can., XII, p. 126.
1880. *Pristiphora grossulariæ* Thomas. 5th Rept. Ins. Ill., p. 69.
1880. *Pristiphora rufipes* Thomas. 5th Rept. Ins. Ill., p. 70.
1883. *Pristiphora grossulariæ* Provancher. Faun. Ent. Can. Hym., II, p. 182.
1883. *Pristiphora grossulariæ* Stoddard. Am. Encycl., I, p. 135.
1883. *Pristiphora grossulariæ* Saunders. Ins. Inj. to Fruits, p. 343.
1890. *Pristiphora appendiculata* Konow. Deutsch. Ent. Zeit., XXXIV, p. 247.

Female.—Length 5 mm.; rather short, robust; head narrow, not nearly so broad as thorax; clypeus truncate; vertex smooth, shining; frontal crest nearly obsolete; antennæ slender, filiform, scarcely longer than head and thorax, joints decreasing in length apically from third; antennal fovea very minute, circular; sheath scarcely projecting, tapering, rather densely clothed with hairs; claws simple; first cubital cross vein entirely wanting. Color black, shining; tegulæ and legs light yellowish; bases of coxæ brown; anterior femora basally infuscated; antennæ fulvous or light yellowish beneath; wings nearly hyaline; veins and stigma yellowish brown. In some specimens the hind femora are also strongly infuscated.

Seven females. New York, Illinois, Missouri, and Colorado. (Coll. U. S. Nat. Mus.)

4. **Gymnonychus resinicolor** new species.

Female.—Length 5 mm.; moderately robust; clypeus squarely truncate; vertex smooth, shining; antennal fovea and ocellar basin obsolete; antennæ slender, scarcely tapering, third and fourth joints subequal; sheath not produced, rounded at tip; cerci very robust, short, acuminate; claws simple; intercostal vein nearly interstitial with basal; stigma broad, rounded on lower margin. Color dark resinous, inclined to reddish; spot about ocelli, center of anterior lobe of mesonotum, most of metanotum, and the center of dorsum of abdomen brownish black; antennæ brownish above; wings clear; veins yellowish brown; stigma lighter, almost hyaline.

One female. Fort Wrangel, Alaska. Mr. H. F. Wickham, collector. (Coll. U. S. Nat. Mus.)

XVIII. Genus **DINEURA** Dahlbom.

Dineura Dahl., Conspect. Tenth. Scand., p. 13, 1835.

SPECIES.

americana Provancher. Nat. Can., XIII, p. 292, ♀, 1882. (Canada.)
lateralis Norton. Trans. Am. Ent. Soc., I, p. 240, ♀, 1867. (Maine.)
linita Norton. Trans. Am. Ent. Soc., I, p. 240, ♀, 1867. (Maine.)
litura Klug. Mag. Ges. Nat. Fr. Berlin, VIII, p. 83, ♀, 1814; Norton. Trans. Am. Ent. Soc., I, p. 240, 1867. (Georgia.)
luteipes Cresson. Trans. Am. Ent. Soc., VIII, p. 11, ♂, 1880. (Canada and Maine.)
pallida Ashmead. Bull. Col. Biol. Assn., I, p. 15, ♀, 1890. (Colorado.)

The species *linita* and *lateralis* are very closely allied, if not identical, and *luteipes* may prove to be merely the male of one of them.

XIX. Genus **HEMICHROA** Stephens.

Hemichroa Steph. Ill. Brit. Ent., Mandib., VII, p. 55, 1838.

SPECIES.

albidovariata Norton. Trans. Am. Ent. Soc., IV, p. 81, ♀, 1872. (Texas and Florida.)
fraternalis Norton. Trans. Am. Ent. Soc., IV, p. 81, ♂, 1872. (Texas.)
nigricans Cameron. Trans. Ent. Soc. Lond., p. 482, 1884. (Mexico.)

The second species, *fraternalis*, will very probably prove to be the male of the first, as indicated both by resemblance and habitat.

APPENDIX.

DESCRIPTIONS OF SPECIES THE TYPES OF WHICH ARE LOST OR INACCESSIBLE.

The types of the following species have either been lost or are inaccessible. The latter applies to the species described by William F. Kirby, the types of which are in the British Museum. It is probable that Eschscholtz's two species are not now obtainable. Of the other species, one each described by Say, Fitch, and Walsh, and the rest by Norton, the type specimens are lost and I have been either unable to recognize them from the rather inadequate descriptions or to secure additional specimens representing them. A few of these species are so characterized that it is possible with tolerable accuracy to refer them to genera, and in such cases I have indicated the probable genus to which they belong. Some of those referred to *Pteronus* may, however, belong to *Amauronematus*, and some of those referred to *Pachynematus* may belong elsewhere. The descriptions by Kirby are so inadequate that nothing can be determined of the position or relationship of his species, and to properly refer them will necessitate an examination of the types themselves. The species the genera of which can not be determined, are all given under the old term *Nematus*, though probably none of them belong in this genus as now restricted. The original descriptions are quoted without change, and, other than those of Kirby's species, are taken from Norton's Catalogue.

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1. Amauronematus (?) fur Walsh.

1866. *Nematus fur* Walsh. Proc. Ent. Soc., Phila., VI, p. 263.
1867. *Nematus fur* Norton. Trans. Am. Ent. Soc., I, p. 206. (Cat., etc., p. 68.)
1895. *Nematus fur* Marlatt. Proc. Ent. Soc., Wash., III, p. 267.

Male.—Length 0.39 inch; br. wing 0.38 inch; black; head opaque, very minutely and closely punctuate, rugose; clypeus, labrum, the extreme tip of the cheek, and the base of the mandibles all dull greenish white; clypeus emarginate in a circular arc of about 45°, with a small tubercle in the middle of its anterior margin; labrum fully as long as wide, its tip rounded; antennæ black, four-fifths as long as body, rather more compressed than is usual in males, fourth and fifth joints equal in length, third shorter by one-fourth; thorax opaque, very minutely rugose, subpol-

ished on the pectus; a pale subtriangular tubercle on the lateral margin of the black, subpolished, basal plate; abdomen subpolished, bright fulvo-rufous, the basal edge of joint 1, next the basal membrane, which is whitish, clouded with black; genitals obfuscated; legs black; wings subhyaline, slightly tinged with fuliginous; veins and stigma black.

Rock Island, Ill.

One male bred March 29, from an old subpedunculed spherical gall of *Cecidomyia s. batatas* Walsh, on *S. humilis*. Female unknown. As the mother sawfly must have deposited her egg in this gall after the gall maker had quit it, or not long before, it is a question if this species can be considered an inquiline.

There is very little doubt but that this is the same with *N. luteotergum* male, which only differs in having the legs in part piceous and in being somewhat smaller.

(See note 2, p. 22.)

2. Pteronus (?) hudsonicus Norton.

1867. *Nematus hudsonicus* Norton. Trans. Am. Ent. Soc., I, p. 207. (Cat., etc., p. 69.)

Black; orbits, mouth, tegulæ, anterior angle, venter, and legs, except a black line on two posterior pair, white; length 0.38; br. wings 0.76 inch.

Female.—Antennæ less than half as long as the body, joints cylindrical, somewhat enlarged at tip, third and fourth of equal length; sutures at sides of ocelli deep; ocelli in a triangular basin; nasus very slightly emarginate; orbits, space about antennæ and mouth beneath, tegulæ, anterior angle (a black line in middle), and the venter whitish, the latter with a row of black spots on each side forming an interrupted black line; scutel large, produced behind a slightly raised angle; legs dull white, with the basal upper half of anterior femora, a line down the upper side of posterior femora, and tibiæ and their tarsi black; anterior inner spur of tibiæ blunt, bifid; inner tooth of claw large; wings hyaline; stigma and costa brown; emargination of stigma distinct.

One female. Fort Good Hope, Mackenzie River, Hudson Bay Territory (R. Kennicott).

3. Pteronus (?) lateralis Norton.

1867. *Nematus lateralis* Norton. Trans. Am. Ent. Soc., I, p. 211. (Cat., etc., p. 73.)

Black; orbits, face below antennæ, pleura, body, body beneath (except breast), and legs pale; length 0.38; br. wings 0.76 inch.

Female.—Antennæ half the length of body, joints cylindrical, third and fourth equal, slightly enlarged at tips; sutures at sides of ocelli deep; lower ocellus in a shallow circular space, which has a distinct ridge around its upper half; nasus produced, distinctly emarginate in middle and at sides; tongue and palpi dark, last joint of maxillary palpi shorter than the preceding; the whole orbits as far as sutures, two spots behind ocelli, a spot above antennæ, space around, and face below reddish white; sutures of metathorax and a bent line between upper wings crossing upper half of scutel rufous; tegulæ, anterior angle, pleura, and body beneath except a black spot on breast reddish white; legs the same color; tarsi fuscous; a slender black line on the upper and lower side of femora, and less distinctly on the posterior tibiæ; anterior inner tibial spur bifid; inner claw tooth large and near the tip; wings hyaline; nervures black; stigma pale, with little or no emargination above; second recurrent nervure received at a distance from the intersection of second and third cells.

Var. Abdomen almost entirely pale.

Three females. Brunswick, Me. (A. S. Packard). Albany, N. Y. (Dr. Peck).

This species, though distinct from, seems somewhat closely allied to my *hyalinus* n. sp.

4. Pteronus longulicornis Norton.

1835. *Nematus longicornis* Say. Boston Journ. Nat. Hist., I, p. 219.
1859. *Nematus longicornis* Say. LeConte, Say's Entomology, II, p. 679.
1861. *Nematus longicornis* Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 158.
1867. *Nematus longulicornis* Norton. Trans. Am. Ent. Soc., I, p. 214. (Cat.,etc., p. 76.)

Black; orbits, face below antennæ, tegulæ, anterior angle, pleura (except black spot on female), the whole body beneath, and legs whitish. Length 0.26; br. wings 0.54 inch.

Female.—Body rather long; antennæ black, more than two-thirds the body, slender, third and fourth joints equal; head rather smooth; sutures at sides of ocelli distinct; lower ocellus in a basin, which is smooth and shining, obovate, with distinct edges; nasus angulate, emarginate; labrum emarginate; a spot on vertex from antennæ to summit, and the back of head black; remainder pale; a slender ridge runs through the groove on anterior lobe of thorax; the tegulæ, anterior angle, pleura, and whole body beneath whitish, except two black spots on pleura, the anterior one large and lunulate; scutel black; sutures of abdomen indistinctly pale; legs pale, with the apical half of hinder femora and tibiæ and their tarsi blackish; inner tooth of claws large and near the tip; wings hyaline; stigma full; nervures and stigma piceous; base of stigma and costa pale.

Male.—Antennæ fulvous beneath, third joint shorter than fourth, curved at base; a straight, black line under the anterior wings; tips of posterior tibiæ blackish, their femora pale; stigma color of costa.

Iowa (Say), Connecticut, New York, Pennsylvania, Great Slave Lake, Hudson Bay Territory.

This species seems to be allied to *cornelli* n. sp.

5. Pteronus (?) nortonii Dalla Torre.

1867. *Nematus fallax* Norton. Trans. Am. Ent. Soc., I, p. 198. (Cat., etc., p. 60.)
1894. *Nematus nortonii* Dalla Torre. Cat. Hym., I, p. 246.

Black; mouth, cheeks, apex of venter, and tibiæ in part reddish white; a black line down the tibiæ above; body slender; length 0.18 to 0.20; br. wings 0.44 to 0.48 inch.

Male.—Shining black; body slender; antennæ rather long and slender, ferruginous beneath; nasus hardly incurved and with mouth below; lower half of cheeks and apex of venter yellow red; legs at base black, below the base of femora yellow red, with a blackish line down their upper side; inner anterior tibial spur stout; inner tooth of claw nearly as large as outer; wings perfectly hyaline, iridescent; stigma somewhat rounded above and with the costa pale greenish.

Labrador (A. S. Packard, jr.). Two males.

6. Pteronus rufofasciatus Norton.

1867. *Nematus rufo-fasciatus* Norton. Trans. Am. Ent. Soc., I, p. 205. (Cat., etc., p. 67.)

Black; a band on the middle of abdomen and most part of legs rufous; wings smoky hyaline; length 0.34; br. wings 0.70 inch.

Female.—Black; body long and moderately stout; antennæ about two-thirds the length of body, slender, cylindrical, third joint but little longer than fourth; head dull, with coarse, confluent punctures; nasus coarsely punctured, deeply channeled across the middle, angulate, emarginate; edge of labrum incurved; outer orbit and a spot opposite ocelli on each side, labrum, and palpi rufous; upper half of anterior angle and basin on each side of scutel rufous; abdomen, except the basal plates and three apical segments, chestnut red; legs the same color; coxæ, except at tip, black; anterior inner tibial spur stout, apparently bifid; inner claw tooth large; wings smoky hyaline, nervures piceous; stigma and costa pale.

Mackenzie River, Hudson Bay Territory (R. Kennicott).

7. Pteronus (?) satkatchewan Norton.

1867. *Nematus satkatchewan* Norton. Trans. Am. Ent. Soc., I, p. 200. (Cat., etc., p. 62.)
1878. *Nematus satkatchewan* Provancher. Nat. Can., X, p. 56.
1883. *Nematus satkatchewan* Provancher. Faun. Ent. Can. Hym., p. 187.

Black; tegulæ black; breast rufous; legs mostly yellow red; wings hyaline; length 0.38; br. wings 0.76 inch.

Female.– Shining black; body long; antennæ long and slender, apical joint shorter than the preceding; the ocelli, seen from before, are each in a separate basin; nasus incurved; fourth joint of palpi short, fifth and sixth longer and very slender; thorax polished; labrum piceous; a large chestnut-red spot on pectus; legs same color; the trochanters and anterior tarsi whitish; posterior tibiæ, except at their base, and their tarsi black; anterior tibial inner spur stout, blunt pilose so as to appear bifid; inner claw tooth large; wings hyaline; stigma black.

Lake Sathkatchewan (Smithsonian Institution). One female.

8. Pachynematus (?) malacus Norton.

1867. *Nematus malacus* Norton. Trans. Am. Ent. Soc., I, p. 196. (Cat., etc., p. 58.)
1878. *Nematus malacus* Provancher. Nat. Can., X, p. 53.
1883. *Nematus malacus* Provancher. Faun. Ent. Can. Hym., p. 185.

Black; tegulæ, trochanters, and legs below knees pale; length 0.28; br. wings 0.60 inch.

Female.—Shining black; body short and stout; antennæ slender, joints of nearly equal length; lower ocellus in a shallow basin; nasus hardly incurved; tegulæ and collar whitish; coxæ, femora, and tips of posterior tibiæ and of all the tarsi black; claws slightly dentate within; trochanters, anterior femora before, tibiæ, and tarsi except at tip white; wings hyaline; stigma and costa pale greenish, second submarginal widest at first recurrent nervure.

Labrador (A. S. Packard, jr.). Three females.

9. Pachynematus (?) nigritus Norton.

1861. *Nematus nigritus* Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 159.
1867. *Nematus nigritus* Norton. Trans. Am. Ent. Soc., I, p. 201. (Cat., etc., p. 63.)

Black; outer orbits and mouth, tegulæ, apex of abdomen, and legs in part pale; length 0.21; br. wings 0.48 inch.

Female.—Black; body slender; antennæ two-thirds the length of body, slightly flattened and enlarged at joints, third joint shorter than fourth; nasus hardly emarginate; an outer orbital line as high as suture, edge of nasus and beneath pale piceous; tegulæ and apex of abdomen and several apical segments of vertex yellowish; trochanters, apical half of femora, tibiæ except tips of hinder pair, and base of tarsi reddish white; remainder black; inner tooth of claw very short, blunt and distinct from outer tooth; wings hyaline, nervures piceous, middle of stigma and base of costa paler; second submarginal cell with one angle below, the second recurrent nervure coinciding with dividing nervure.

Connecticut. Two males. This may be the male of *N. subalbatus*.

10. Pachynematus (?) sumptus Norton.

1867. *Nematus sumptus* Norton. Trans. Am. Ent. Soc., I, p. 207. (Cat., etc., p. 69.)

Black; mouth, orbits, and tegulæ white; basal half of abdomen, spot on pleura; and most part of legs rufous; length 0.28; br. wings 0.62 inch.

Male.—Body long; head large; mouth below antennæ, the outer orbits extending over the back of head, and a narrow inner orbital line interrupted opposite ocelli yellow; nasus emarginate; tegulæ and anterior angle whitish; abdomen chestnut

red, the two apical segments blackish; an indistinct, piceous, perpendicular spot on pleura near breast; coxæ and trochanters whitish; remainder of legs rufous, paler before, except the posterior tibiæ and tarsi, which are blackish; hinder tibiæ somewhat swelled; inner tooth of claws very obtuse, hardly visible; wings hyaline, faintly smoky; stigma dark brown.

Maine (A. S. Packard). One male.

11. Lygæonematus (?) monela Norton.

1867. *Nematus monela* Norton. Trans. Am. Ent. Soc., I, p. 198. (Cat., etc., p. 60.)
1878. *Nematus monela* Provancher. Nat. Can., X, p. 54.
1883. *Nematus monela* Provancher. Faun. Ent. Can. Hym., p. 184.

Black; mouth, spot on cheeks, tegulæ, collar, and venter pale; base of coxæ and of femora and tips of hinder tibiæ black; length 0.20; br. wings 0.48 inch.

Male.—Black; body slender; antennæ slightly compressed, third joint hardly as long as fourth; lower ocellus in a small basin; nasus emarginate; edge of nasus, labrum, and spot at base of mandibles white; tegulæ, two edges of anterior angle, and apex of venter yellow red; legs yellow red; trochanters white; base of coxæ, base of femora and a line beneath extending nearly to tip, apex of posterior tibiæ, and their tarsi black; inner apical tarsal spur blunt; inner claw tooth small and widely separated from outer; wings hyaline; stigma and costa pale, waxen color.

Labrador. Two males. (Mr. Packard.)

12. Nematus calais Kirby.

1882. *Nematus calais* Kirby. List. Hym. Brit. Mus., I, p. 144.

Exp. al. 8 lin.; long. corp. 4 lin.

Female.—Head and thorax black, finely punctured; pleura and pectus shining; abdomen testaceous, the last two segments blackish; legs testaceous, four front femora blackish at base, intermediate tibiæ with a dark line above; hind tibiæ and tarsi blackish, the former rather widened and flattened; wings hyaline, with piceous stigma and nervures; fore wings clouded in the middle, and with apparently only three submarginal cells, the two first being divided by a white nervure.

Arctic America, Mackenzie River.

13. Nematus castaneus Kirby.

1882. *Nematus castaneus* Kirby. List Hym. Brit. Mus., I, p. 147.
1893. *Nematus castaneus* McGillivray. Can. Ent., XXV, p. 237.

Exp. al. 9 lin.; long. corp. 4¼ lin.

Female.—Chestnut color; head, mesothorax, and pleura darker; antennæ, a large square spot on the vertex, a spot in front of the thorax, and the pectus black; an irregular spot covering the hinder half of the scutellum, the postscutellum, a portion of the first segment of the abdomen, and extremities of hind tibiæ and hind tarsi dusky; wings hyaline, fore wings slightly yellowish; stigma and nervures piceous.

Hudson Bay, St. Martin's Falls, Albany River.

14. Nematus extraneus Kirby.

1882. *Nematus extraneus* Kirby. List Hym. Brit. Mus., I, p. 142.

Exp. al. 7 lin.; long. corp. 3 lin.

Female.—Testaceous; two basal joints of antennæ, a large irregular spot on vertex, and three large spots on the thorax black; abdomen with a black band in the middle, covering most of the three first segments and expanded on the three following ones, ceasing with segments 7 and 8, on which it is not expanded; extremities of hind tibiæ and of joints of hind tarsi slightly marked with blackish above; wings hyaline; costa and stigma pale yellowish; three submarginal cells.

Hudson Bay, St. Martin's Falls, Albany River

15. Nematus inconspicuus Kirby.

1882. *Nematus inconspicuus* Kirby. List Hym. Brit. Mus., I, p. 141.

Exp. al. 8 lin.; long. corp. 4 lin.

Female.—Head, antennæ, thorax, and pectus black; mouth and prothorax yellowish; abdomen black above and testaceous beneath, with a narrow border on the sides and at the back of each segment; legs testaceous; wings hyaline; costa yellowish; three submarginal cells.

New York.

16. Nematus longicornis Eschscholtz.

1822. *Nematus longicornis* Eschscholtz. Entomogr., p. 98.

1823. *Nematus longicornis* Eschscholtz. Nat. Abh. Dorp., I, p. 149.

1867. *Nematus longicornis* Norton. Trans. Am. Ent. Soc., I, p. 202. (Cat., etc., p. 64.)

Black, with the margin of tergum fuscous; the venter and legs pale, posterior femora black, costa of wings pale, stigma brown, head black, labrum yellowish, eyes clear gray; length 2½ lines; antennæ longer than the moiety of body, setaceous, black; corselet black, its anterior border forming a yellowish collar; abdomen wide, flat; back brownish; lateral margins of a clear yellow; venter yellow; wings longer than the body, narrow, transparent; costa yellow; stigma and nervures brown; three discoidal cells; legs yellow; posterior femora black-brown in the middle.

Isle of Unalaska, Russian America.

17. Nematus neglectus Kirby.

1882. *Nematus neglectus* Kirby. List Hym. Brit. Mus., I, p. 147.

Exp. al. 8 lin.; long. corp. 4 lin.

Female.—Head and thorax black; mouth and prothorax pale; a more or less complete testaceous ring around the eyes; sides of pectus sometimes with a dull rufous spot; abdomen testaceous, first two segments black at base above; legs testaceous; front femora black at base; middle femora and hind legs black; hind tibiæ rufous beneath; wings hyaline, male with three and female with four submarginal cells; stigma yellowish.

Hudson Bay, St. Martin's Falls.

18. Nematus obscurus Norton.

1861. *Nematus obscurus* Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 160.

1867. *Nematus obscurus* Norton. Trans. Am. Ent. Soc., I, p. 203. (Cat., etc., p. 65.)

Dull black; tegulæ, base of abdomen, and knees indistinctly ferruginous; length 0.25; br. wings 0.58 inch.

Female.—Black, pubescent; third joint of antennæ a little longer than fourth; clypeus crenate; labrum brownish red, shining; mandibles rufous at tip; palpi pale; a longitudinal groove upon scutellum; basal membrane, sides of tergum, knees, and front of tibiæ indistinctly ferruginous; abdomen stout; wings faintly clouded; stigma dull fuscous; costa black.

Massachusetts.

19. Nematus obtusus Kirby.

1822. *Nematus crassus* Eschscholtz. Entomogr., p. 213.

1823. *Nematus crassus* Eschscholtz. Naturw. Abh. Dorp., I, p. 149.

1867. *Nematus crassus* Norton. Trans. Am. Ent. Soc., I, p. 213. (Cat., etc., p. 75.)

1882. *Nematus obtusus* Kirby. List Hym. Brit. Mus., I, p. 148.

Black; sides of the head, lines on the thorax, scutellum, and pleura chestnut; tibiæ pale; length 4 lines.

Body thick; head black in the middle, of a nut brown on the sides; parts of the

mouth yellow; antennæ longer than the moiety of the body, filiform, black; border of the corselet brown; two longitudinal lines on the thorax; scutel and the greater part of the thorax of a chestnut brown; abdomen convex, shining black; wings longer than the body, wide, transparent; stigma and costa yellow; nervures brown; marginal cell simple, extending almost to the tip; three discoidal cells; legs yellow; a long black spot under the anterior femora; posterior femora black, at the extremity yellow.

Isle of Unalaska, Russian America. Not seen (Norton).

20. **Nematus suratus** Fitch.

1856. *Nematus suratus* Fitch. 3d Rept. N. Y. Agr. Soc., p. 315, No. 94. (3rd Rept. Ins. N. Y., p. 68.)

1861. *Nematus suratus* Norton. Proc. Bost. Soc. Nat. Hist., VIII, p. 159.

1867. *Nematus suratus* Norton. Trans. Am. Ent. Soc., I, p. 196. (Cat., etc., p. 60.)

Black, with four transparent, slightly smoky wings; mouth, cloud-like spot on the shoulders, edges of abdominal segments, and legs livid white; the four anterior thighs being black upon their undersides and the hinder pair wholly black, except at their base; length 0.25 inch; to the tip of wing 0.30 inch.

New York. Not seen (Norton).

Food-plant, cherry.

21. **Nematus trifurcatus** Kirby.

1882. *Nematus trifurcatus* Kirby. List Hym. Brit. Mus., I, p. 148.

Exp. al. 8 lin.; long. corp. 4 lin.

Female.—Testaceous; antennæ black; a large square black spot on vertex; three large black spots in front and on the sides of the thorax, sometimes nearly confluent; hinder half of the scutellum black; all the segments of the abdomen except the last (beyond which the black tips of the saws and sheaths project) are more or less broadly banded with purplish black in the middle; sides and under surface testaceous; fectus black in the middle; a black line down the hind legs; wings hyaline; nervures piceous; stigma yellowish; three submarginal cells.

This species appears to be allied to *N. crassus* Esch. (*obtusus* Kirby), from Alaska.

Hudson Bay, St. Martin's Falls, Albany River.

22. **Nematus abbotii** Kirby.

1882. *Hypolæpus abbotii* Kirby. List Hym. Brit. Mus., pp. 324–325.

Exp. al. 11 lin.; long. corp. 6 lin.

Female.—Blue black, shining; third segment of abdomen testaceous on the sides, and less distinctly so above; wings iridescent, clear hyaline toward the base, and more dusky beyond, with blackish nervures.

North America (Georgia). Probably from Abbott's collection.

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TECHNICAL SERIES NO. 4.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

SOME

MEXICAN AND JAPANESE INJURIOUS INSECTS

LIABLE TO BE

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., April 15, 1896.

SIR: I have the honor to submit for publication the fourth number of the technical series of bulletins of this Division. It is composed of a group of articles, chiefly of a descriptive character, which relate to injurious insects liable to be imported into the United States.

Respectfully,

L. O. HOWARD,
Entomologist.

HON. J. STERLING MORTON,
Secretary of Agriculture.

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INTRODUCTION.

Of the articles which compose this bulletin, three relate to Mexican insects, one specifically to Japanese insects, and two to insects which enter the port of San Francisco, mainly from Japan but also from other Pacific ports, principally those of Hawaii and Australasia. In a paper read before the Peninsula Horticultural Society, at Dover, Del., on January 11, 1895, and published in Insect Life (vol. VII, pp. 332–339), the writer called especial attention to the great and constant danger of the importation of injurious insects new to the United States, and sounded an especial note of warning regarding the Mexican border. One of his first official acts on assuming charge of the Division of Entomology in June, 1894, was to secure the temporary appointment of Prof. C. H. Tyler Townsend to conduct a brief investigation of the injurious insects of northern Mexico which are liable to be carried across the border, and the first three papers of this bulletin give the technical results of this short investigation, the first paper, by Professor Townsend himself, possessing also some popular interest. The whole subject, as a matter of fact, is one which deserves popular as well as technical treatment, and a popular summary may be given at another time. Our danger from Mexico is fast becoming realized. A great influence in bringing about popular appreciation of this danger has been the advent in Texas cotton fields of the Mexican cotton boll weevil, *Anthonomus grandis*, and quite recently resolutions have been adopted by the Board of Control of the New Mexico Agricultural Experiment Station, recommending the stationing of horticultural quarantine officers at southern ports and the appointment of an agent of this Department to study injurious insects in Mexico, Central America, and the West Indies.

There is fortunately not the same danger of the importation of injurious insects from Japan and the Pacific islands that there is from Mexico. This is largely owing to the excellent legislative acts which are in force in California and to the work of the State Board of Horticulture. It is necessary, however, for even the executive officers of the State Board of Horticulture of California to be familiar with the insects which are liable to be imported, and it was with this fact in view that my predecessor in office, Prof. C. V. Riley, secured the services for a short time of Mr. Otoji Takahashi, a Japanese entomologist who had been trained by Prof. J. H. Comstock at Cornell University, to conduct a short investigation, particularly of the scale insects affect-

ing citrus plants. Mr. Takahashi's employment was brief, and he was unfortunately situated at a great distance from the orange-growing region. He secured, however, several interesting scale insects, which are described by Professor Cockerell in the concluding article of the series. Of the injurious insects of Japan other than scale insects we should have a more explicit knowledge. We already know of the existence there of a larva affecting the peach, an account of which was given in Insect Life (vol. II, pp. 64–66), which would be a most undesirable importation. We also know that the Japanese gypsy moth, *Ocneria japonica*, if accidentally introduced into this country, might prove as serious a pest as the European gypsy moth has shown itself to be in Massachusetts. But with other injurious insects of this and other orders we are more or less unfamiliar. Further investigations in this line are, therefore, very much to be desired.

In 1893 a large collection of unnamed Japanese insects of different orders was exhibited at the Chicago Exposition by Dr. K. Mitsukuri, of the Imperial University, Tokyo, Japan. This collection was deposited in the U. S. National Museum at Washington, and is now being named by specialists in different orders. Many of the insects are undoubtedly injurious, but we have no notes of their exact habits. Quite recently a small lot of Japanese insects was sent to the writer by Mr. M. Matsumura, of the Sapporo Agricultural College, who is taking up economic entomology, and as these specimens were accompanied by notes as to food plants the sending was an exceptionally interesting one. Among them the following are of especial interest:

Spilodes kodzukalis Holland MS.; very injurious as a stalk borer to grasses.

A species of Ancylolomia very like our *Chilo oryzaellus;* very injurious to rice stalks as a borer.

Rhodophæa hollandella Ragonot; rolling the leaves of pear.

Nephopteryx rubrizonella; boring into the fruit of pear.

Cacœcia rosaceana Harris; rolling leaves of apple. (This species occurs abundantly in this country.)

Hyponomeuta sp.; eating the leaves of apple and pear.

Orgyia gonostigma (a common European species); eating the leaves of apple and pear.

Laverna? sp.; very injurious to apple, working in the fruit like the codling moth and spinning its cocoon in the earth.

Exartema? sp.; an injurious bud moth of the mulberry tree.

Tinea sp.; near *granella;* attacking stored rice.

Myelois sp.; attacking stored grain.

Bombyx mandarinus Moore (the species which is believed to be the wild form of the silkworm of commerce); eating the leaves of the mulberry tree.

Stenobothrus bicolor Charp. (?); a grasshopper which is very injurious to vegetation in general.

Parapleurus alliaeus Germ. (?); another grasshopper which attacks the rice plant.

Sitodrepa panicea (cosmopolitan); very troublesome to stored food. (One specimen of *Ptinus fur* was found with the preceding.)

Tabanus sp.; attacking domestic animals.

The Lepidoptera of this collection were examined by Rev. Dr. W. J. Holland, who has given us most of the names, and the two grasshoppers were named by Professor Bruner.

The publication of the list of scale insects found upon plants entering the port of San Francisco, by Mr. Alexander Craw, quarantine officer and entomologist of the State Board of Horticulture of California, renders this bulletin far more complete than it could otherwise have been made, and Mr. Craw's courtesy in furnishing this list is highly appreciated. The technical descriptions of new forms found by Mr. Craw have been drawn up by Professor Cockerell, to whom they were sent by Mr. Craw with the request that the manuscript be forwarded to this office for publication in this bulletin.

The publication of these technical matters in the present shape is desirable, for the reason that it will place upon record facts and descriptions concerning the species mentioned which will enable an entomologist to recognize any of the forms discussed, in case at any time they appear or establish themselves in any part of the country. Thus, if an injurious scale insect is brought to the attention of the entomologist of the Louisiana Experiment Station, for example, and he finds that it is new to his locality, he can probably, by consulting these pages, ascertain whether it was imported from Mexico or from some other point. Having ascertained that it is an importation, and perhaps a recent one, the necessity for exterminating, and not palliative remedial work, will be at once apparent.

Further investigations of this character are, as stated above, very much to be desired. Results of more immediate value are, however, to be obtained on other lines of work, and the Entomologist has felt loath to recommend the spending in this direction of more than a very small part of the funds at his disposal.

L. O. H.

SOME MEXICAN AND JAPANESE INJURIOUS INSECTS LIABLE TO BE INTRODUCED INTO THE UNITED STATES.

REPORT OF A TRIP TO INVESTIGATE INSECTS OF ECONOMIC IMPORTANCE IN MEXICO.

By C. H. Tyler Townsend,
Temporary Field Agent, Division of Entomology.

LETTER OF SUBMITTAL.

Las Cruces, N. Mex., *October 31, 1894.*

Sir: I have the honor to submit the inclosed report on my investigations of economic insects in Mexico, made between September 20 and October 20, 1894. Pursuant to your instructions, I visited most of the principal agricultural districts situated along the railroads over the plateau region, and also visited the ports of Guaymas and Tampico. On growing crops little else was met with besides scale insects (Coccidæ) and their enemies. These are of the utmost economic importance, and, therefore, were carefully collected and are all mentioned in this report, whether found on crops or other plants. Whenever practical, ranches and plantations of importance in the vicinity of stopping places were visited and thoroughly inspected; but when the distance was so great or the time so short as to render such trips impracticable the time was devoted to the inspection of all available plazas, gardens, patios, etc., in the different places visited. The idea was constantly kept in mind that those species which occurred in regions from which much produce was shipped were more likely to become imported, and inquiries were made of proper authorities in this regard.

Very respectfully, yours,

C. H. Tyler Townsend,
Temporary Field Agent.

Mr. L. O. Howard,
Chief, Division of Entomology,
U. S. Department of Agriculture.

INTRODUCTORY.

The present report treats of such insects of economic importance as could be found in Mexico in the limited time at my disposal for visiting the different agricultural districts, and which stand any chance of being introduced into the United States. Only such regions as are situated along the railroads were visited, ports excepted, as from these only would pests be liable to reach our country through shipment of fruit, produce, plants, etc. Enemies of injurious insects were collected

wherever found, and some of these may prove of importance for introduction, i. e., certain enemies of scale insects.

My thanks are due to Mr. Charles E. Hale, American vice-consul at Guaymas; Hon. John Maguire, American consul at Tampico; Señor U. Ferreira, of Hermosillo, a well-informed man on scale insects of the orange; and to many others for favors shown and assistance given.

All of the material outside of the Coccidæ was determined by the Department in Washington—the Encyrtinæ and Aphelininæ by Mr. Howard, the Coleoptera by Mr. Schwarz, and the few Diptera by Mr. Coquillett. The plants were determined by Mr. Coville. My thanks are due to these gentlemen, and also to Prof. T. D. A. Cockerell, of Las Cruces, N. Mex., who at first looked over the coccids superficially and furnished me comments and notes upon them. They were then worked over by Mr. Pergande, who determined the most of the described species. The new species were afterwards described and named by Professor Cockerell, and appear in a paper at the end of this report. I should also mention that a considerable part of the list of Mexican Coccidæ was made from data furnished me by Mr. Cockerell.

SCALE INSECTS (COCCIDÆ).

The scale insects form the major portion of the material secured, and will be treated first under the head of each species. Following this will be given a list of species found on each plant infested.

1. *Icerya purchasi* Mask.—This species was found only on citrus fruits, principally orange, at Guaymas, Hermosillo, and Magdalena in the State of Sonora; at Victoria in Tamaulipas, and at Monterey in Nuevo Leon.

In Guaymas it was found very bad on about six orange trees at Aranjuez, at a place formerly known as San Jose de Guaymas. On trunk, twigs, and leaves, September 23.

Señor U. Ferreira informed me that the Icerya has been seen on grapes at Hermosillo; and further, that no other scale has ever occurred on orange in Hermosillo except the Icerya. The same gentleman informed me also that when the Icerya on the orange was shown to the native Mexicans, they replied that they had previously observed the same on the mesquite, but the latter was probably a different species.

At Hermosillo it was found in the plaza on orange, and very sparingly in the orange orchards of that vicinity. At Magdalena it was found in great abundance on some orange trees in the patio of a hotel and in the plaza, and on one lime tree in the same place. At Victoria it was found in large numbers on orange; October 16 on leaves along midrib on underside. At Monterey it occurred on orange trees in one of the plazas.

This species is found elsewhere in California, Florida, Australia, New Zealand, South Africa, and the Sandwich Islands.

2. *Orthezia sonorensis* Ckll. n. sp.—Found numerously near San Ignacio, Sonora, September 26, on plant called "gecota," *Hymenoclea monogyra*. This is a large species of Orthezia, larger than any hitherto known.

3. *Orthezia insignis* Dougl., var.—Found abundantly on many orange trees in Guadalajara, October 9 and 10, in different parts of the city. In Aguas Calientes it was extremely abundant on a small lime tree October 11, covering the whole tree. A single specimen was also found on tomato.

The true *insignis* is found out of doors only in Jamaica, Trinidad, and Demerara. It occurs in hothouses in Europe and America. A variety, probably the same, was found in Vera Cruz by Cockerell.

4. *Chionaspis citri* Comst.—Found abundantly in Tampico, October 14, on orange. It was very bad on leaves, fruit, twigs, and bark of trunk and branches; also badly infesting tangerine orange in Tampico.

This species is found elsewhere in Cuba, Louisiana, Trinidad, Demerara, Australia, and New Zealand.

5. *Ceroplastes ceriferus* Anders.—This was found in Cuautla on red-flowering Hibiscus, badly massed on branches in plaza, October 7. A lepidopterous larva was found preying upon it.

This species furnishes the Indian white wax, and occurs elsewhere in India, Australia, Antigua, and probably Brazil. It has been collected in Guanajuato, Mexico, by Dr. A. Dugès.

6. *Ceroplastes mexicanus* Ckll. n. sp.—San Luis Potosi, October 12, on Catalpa. Adult scales found singly on branches, and what appear to be the young on upper side of leaves. Also found on *Tecoma stans* at Guaymas, September 24.

7. *Aspidiotus ficus* Ashm.—Very bad on fruit and leaves of orange in plaza in Tampico, October 14. Also very bad on tangerine orange in Tampico. Also bad on orange in Matamoras, December 9. In Chihuahua, on leaves of tree called "palo dulce."

This species occurs elsewhere in Florida, Cuba, Jamaica, and Australia. It has been recorded from Vera Cruz, Mexico, by Cockerell.

8. *Aspidiotus nerii* Bouché.—Very bad on oleander in Chihuahua and Aguas Calientes; also on shrub called "trueno" in Aguas Calientes and San Luis Potosi. Massed on branches of rose in Chihuahua. On leaves of olive and "palo dulce" in Chihuahua. On *Yucca aloifolia* ? (young plants in pots), in Guadalajara.

This species is almost general in distribution, yet, strange to say, has never been found in the West Indies.

9. *Aspidiotus articulatus* Morg.—On orange in Tampico, October 14, associated with *A. ficus*.

Occurs also in Jamaica, Barbados, Nevis, Trinidad, and Demerara; collected by Cockerell in Vera Cruz.

10. *Aspidiotus scutiformis* Ckll.—Abundant on leaves of orange in Victoria and Monterey; also on leaves of pomegranate in Monterey. In the latter place it was especially bad on almost all of the orange trees in all the plazas of the city, the fruit and leaves being simply massed with it.

11. *Aspidiotus* n. sp.—Thickly massed on bark of limbs and twigs of tree said to be avocate (avocado pear). San Luis Potosi, October 12.

12. *Aspidiotus* n. sp.?—On leaves of tree known as "bagote." Hermosillo, September 25. The material was not in sufficient quantity for description.

13. *Aspidiotus nigropunctatus* Ckll. n. sp.—On "trueno." San Luis Potosi, October 12.

14. *Aspidiotus* n. sp.?—On leaves of rose. Monterey, October 17. Not enough material for description.

15. *Lecanium oleæ* Bern.—On orange, lime, and Catalpa, San Luis Potosi; on oleander, "marguerita," and Pelargonium, Aguas Calientes; on thorny shrub (hard wood and thorns few), Las Esteros, State of Tamaulipas; bad on leaves, twigs, and branches of fig trees, Monterey; on guava, Nuevo Laredo, December 13. Those found on oleander at Aguas Calientes were all infested with a large parasite. They occurred on leaves and branches. Those on fig at Monterey were also badly parasitized. This species is widely distributed.

16. *Lecanium hesperidum* Linn.—On lime, San Luis Potosi; on orange, Tampico and Chihuahua; on leaves, stems, and twigs of orange trees in sheltered patios in Chihuahua; also very numerously infesting leaves of several large trees of what is known as "fitolaca," in Monterey, October 17. These last were extensively preyed upon by larvæ and adults of *Ozya orbigera*. On guava and rose, Nuevo Laredo, December 13. This species is found in the Sandwich Islands, South Africa, Florida, Jamaica, Chile, etc.

17. *Lecanium imbricatum* Ckll. n. sp.—On Mimosa. Alta Mira (State of Tamaulipas), October 15. Massed on twigs, the scales overlapping each other.

18. *Lecanium* sp. (?)—Several oblong scales on pods of Catalpa, San Luis Potosi, October 12. This species was overlooked at the Department in making the determinations, and is doubtfully referred by me to this genus. The scales occurred singly on the pods.

19. *Pulvinaria* n. sp.?—Found singly on leaves of "fitolaca," at Monterey. With *Lecanium hesperidum*. Specimens were lost in transit to Washington, and were not reported on at the Department.

20. *Aulacaspis rosæ* Bouché.—Thickly massed on rose branches. Chihuahua. Found elsewhere in the United States, Jamaica, Demerara, Europe, New Zealand.

21. *Aulacaspis boisduvalii* Sign.—On *Bromelia pinguin*, a plant nearly allied to the pineapple, growing wild in tropical America and forming impenetrable thickets in southern Tamaulipas. Alta Mira, Tamaulipas. Known in Jamaica, Barbados, and Trinidad.

22. *Mytilaspis gloveri* Pack.—Very bad on leaves and fruit of orange in Tampico, associated with *Chionaspis citri* and *Aspidiotus ficus*. Also on orange in Matamoras, December 9. This species is new to Mexico. It is found elsewhere in Louisiana, Florida, and Southern Europe.

23. *Pseudococcus yuccæ* Coq.—This species was found by me on the following plants in the following localities:

Tlaltizapan (State of Morelos): Sparingly on a lime tree. Mexico City: On tall *Yucca* (*Y. filifera* probably) in Plaza Guardiola; very bad, covering all the leaves; on banana (1892). Guadalajara: On orange, yellow-variegated Agave, banana, Yucca, Caladium. Aguas Calientes: On common red-flowering Pelargonium, and on Amaryllis. San Luis Potosi: On orange, lime, cherimoya, a malvaceous white-flowering tree, a shrub with red, honeysuckle-like flowers and rose-like leaves, Lantana sp., pomegranate, and Catalpa. Tampico: A few on orange. Las Esteros (Tamaulipas): On thorny shrub, October 15. Monterey: Numerous on leaves of fig trees. This species was very bad on all the orange trees in Guadalajara, and very numerous on Yucca, Agave, and stems and leaves of Caladium. In San Luis Potosi it was very bad on green fruit of orange (also on leaves and branches), on lime, and clustered in white masses on the fruit of cherimoya, but not on the leaves of latter. It attacks a great variety of plants.

It occurs elsewhere in California only. Professor Cockerell does not consider it to be a true Pseudococcus, but probably a new genus. Individuals with 8-jointed antennæ were described by Cockerell as *Dactylopius mexicanus*.

24. *Eriococcus dubius* Ckll. n. sp.—Valles, October 13. On twigs of unknown shrub.

25. *Conchaspis angræci* var. *hibisci* Ckll. var. nov.—Found on leaf stems and twigs of *Hibiscus floridanus* in plaza in Tampico, October 14.

C. angræci (typical form) is known only from Jamaica and from hothouses in England.

The following three new species were collected in Ciudad Porfirio Diaz (Piedras Negras), Coahuila, in November, while engaged on an investigation of the cotton boll weevil, and are included (as are other data gained at the same time) in this report so as to complete the account of Mexican scale insects to the present time:

26. *Aspidiotus yuccæ* Ckll. n. sp.—On *Yucca australis* (or a closely allied species). C. P. Diaz. Thickly covering the leaves, especially toward base.

27. *Aspidiotus townsendi* Ckll. n. sp.—On leaves of unknown tree. C. P. Diaz.

28. *Dactylopius olivaceus* Ckll. n. sp.—In cavities in leaves of *Yucca australis*. C. P. Diaz.

Negative results.—In the vicinity of Magdalena, Sonora (at Magdalena and San Ignacio), I examined many grapes, apples, plums, pears,

peaches, figs, apricots, pomegranates, and quinces, but found no scales whatever on any of these in this region. At San Ignacio, which is six miles north of Magdalena and on the railroad also, I could find nothing on orange, lime, etc., though *Icerya purchasi* abounded on the same at Magdalena. Olives in Hermosillo had no scales.

In Chihuahua nothing was found on peaches or pears. Also nothing on shrub called "trueno," which was abundantly infested farther south. Some scales were found on pomegranate at San Luis Potosi and Monterey, but nowhere else on that plant. No scales were found on fig except in Monterey.

No scales were found anywhere in Mexico on peach, pear, apricot, plum, apple, quince, or grape.

LIST OF SCALE INSECTS, ARRANGED BY HOST PLANTS.

AGAVE (yellow variegated).—*Pseudococcus yuccæ*. Guadalajara.

AMARYLLIS.—*Pseudococcus yuccæ*. Aguas Calientes.

AVOCATE (avocado pear).—*Aspidiotus* n. sp. San Luis Potosi.

BAGOTE.—*Aspidiotus* n. sp.? Hermosillo.

BANANA.—*Pseudococcus yuccæ*. Guadalajara, Mexico City (seen in 1892).

BROMELIA PINGUIN.—*Diaspis boisduvalii*. Alta Mira (Tamaulipas).

CALADIUM.—*Pseudococcus yuccæ*. Guadalajara.

CATALPA.—*Ceroplastes mexicanus; Lecanium oleæ, Lecanium* sp. (?); *Pseudococcus yuccæ*. San Luis Potosi.

CHERIMOYA.—*Pseudococcus yuccæ*. San Louis Potosi.

FIG.—*Lecanium oleæ; Pseudococcus yuccæ*. Monterey.

FITOLACA.—*Lecanium hesperidum; Pulvinaria* n. sp.? Monterey.

GUAVA.—*Lecanium hesperidum; Lecanium oleæ*. Nuevo Laredo.

HIBISCUS FLORIDANUS (red-flowering tropical shrub).—*Ceroplastes ceriferus*: Cuautla. *Conchaspis angræci* var. *hibisci*: Tampico.

HYMENOCLEA MONOGYRA (gecota).—*Orthezia sonorensis*. San Ignacio, Sonora.

LANTANA sp.—*Pseudococcus yuccæ*. San Luis Potosi.

MARGUERITA.—*Lecanium oleæ*. Aguas Calientes.

MIMOSA.—*Lecanium imbricatum*. Alta Mira.

OLEANDER.—*Aspidiotus nerii:* Aguas Calientes, Chihuahua. *Lecanium oleæ:* Aguas Calientes.

OLIVE.—*Aspidiotus nerii*. Chihuahua.

ORANGE, LIME, ETC. (citrus fruits).—*Icerya purchasi:* Guaymas, Hermosillo, Magdalena, Victoria, Monterey. *Aspidiotus ficus:* Tampico, Matamoras. *Aspidiotus articulatus:* Tampico. *Aspidiotus scutiformis:* Victoria, Monterey. *Mytilaspis gloveri:* Tampico, Matamoras. *Chionaspis citri:* Tampico. *Orthezia insignis* var.: Aguas Calientes, Guadalajara. *Lecanium hesperidum:* San Luis Potosi, Chihuahua, Tampico. *Pseudococcus yuccæ:* San Luis Potosi, Guadalajara, Tlaltizapan, Tampico.

PALO DULCE.—*Aspidiotus ficus; Aspidiotus nerii*. Chihuahua.

PELARGONIUM.—*Lecanium oleæ; Pseudococcus yuccæ*. Aguas Calientes.

POMEGRANATE.—*Aspidiotus scutiformis:* Monterey. *Pseudococcus yuccæ:* San Luis Potosi.

ROSE.—*Aspidiotus nerii:* Chihuahua. *Aspidiotus* n. sp.?: Monterey. *Aulacaspis rosæ:* Chihuahua. *Lecanium hesperidum:* Nuevo Laredo.

TECOMA STANS.—*Ceroplastes* n. sp.? Guaymas.

TRUENO (lilac-like shrub).—*Aspidiotus nerii:* Aguas Calientes, San Luis Potosi, *Aspidiotus nigropunctatus;* San Luis Potosi.

YUCCA FILIFERA, AUSTRALIS, AND OTHER SPECIES.—*Pseudococcus yuccæ:* Mexico City, Guadalajara. *Aspidiotus yuccæ:* Ciudad Porfirio Diaz. *Aspidiotus nerii:* Guadalajara. *Dactylopius olivaceus:* Ciudad Porfirio Diaz.

UNKNOWN PLANT.—*Eriococcus dubius.* Valles (Tamaulipas).

PREVIOUS RECORDS OF SCALES INFESTING PLANTS IN MEXICO.

The following are previous records of host plants of scales in Mexico, and complete what is known on this subject up to the present time. I am indebted to Mr. Cockerell for these data:

Aspidiotus articulatus. On rose, Vera Cruz.
Aspidiotus ficus. On rose, Vera Cruz.
Aspidiotus scutiformis. On tree resembling avocado pear. Soledad (Vera Cruz).
Lichtensia lutea. On Croton, Vera Cruz.
Lecanium hesperidum. On rose, Vera Cruz.
Lecanium terminaliæ. On liliaceous plant, Vera Cruz.
Ceroplastes irregularis. On Atriplex, Montezuma (Chihuahua).
Ceroplastodes niveus. On spiny shrub, Montezuma.
Mytilaspis philococcus. On cactus, Guanajuato. (Not a *Mytilaspis* s. str.)
Coccus tomentosus. On cactus, Guanajuato, Silao.
Coccus cacti. On cactus.
Icerya palmeri. On grape, Guaymas.
Llaveia axinus. On Jatropha and Spondias, Tlacotalpan (Vera Cruz State).
Capulinia sallei. On "capulino."
Dactylopius citri. On coffee, State of Michoacan.[1]
Lecanium schini. On *Schinus molle.*
Ceroplastes psidii *subsp.* cistudiformis. On Bignonia and Chrysanthemum, Guanajuato.
Ceroplastes ceriferus. On Malva viscus, Guanajuato.
Tachardia mexicana. On Mimosa, Tampico.
Aspidiotus mimosæ. On Mimosa, Tampico.

IMPORTANT ENEMIES OF SCALE INSECTS FOUND IN MEXICO.

The following are native parasites and predatory species collected in Mexico by the writer with the foregoing 25 species of coccids. They number 27 species:

1. *Perissopterus mexicanus* How.—Bred from *Lecanium hesperidum* on lime, San Luis Potosi. From *Pseudococcus yuccæ* on Agave, Guadalajara.

2. *Aphelinus diaspidis* How.—A yellow parasite bred from *Aspidiotus nerii* on trueno. San Luis Potosi.

3. *Coccophagus mexicanus* How.—Bred from *Lecanium hesperidum* on orange, Chihuahua. *Aleyrodes corni* (?) on lime, San Luis Potosi.

4. *Coccophagus flavoscutellum* Ashm.—Bred from *Lecanium* sp. (?) on Mimosa. Alta Mira (Tamaulipas).

5. New genus of *Encyrtinæ.*—Bred from *Pseudococcus yuccæ* on fig. Monterey.

6. New genus of *Encyrtinæ.*—Bred from *Lecanium oleæ* on fig. Monterey.

7. *Encyrtus* n. sp.—Bred from *Pseudococcus yuccæ* on Pelargonium. Aguas Calientes.

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[1] In the November 8, 1884, number of El Progreso de Mexico there is a long article by Dr. Jose C. Segura on the coffee scale, there identified as *Dactylopius destructor* (=*D. citri*). The localities given are Orizaba, Cordova, Uruapan, Ario, Cuicatlan, Jacona, Tacambaro, and doubtfully Coatepec (near Jalapa). It is said to be worse in the cafetals of Orizaba and Uruapan.—C. H. T. T.

8. *Signiphora* sp.—A black parasite bred from *Aspidiotus nerii* on trueno. San Luis Potosi.

9. *Eupelmus* sp.?—Bred from *Lecanium oleæ* on oleander. Aguas Calientes.

10. *Habrolepis* n. sp.—Bred from *Aspidiotus* n. sp.? (related to *A. perseæ* and *A. fodiens*) on orange. Monterey.

11. *Homalotylus* n. sp.—Bred from *Pseudococcus yuccæ* on Agave, Guadalajara. This genus is known to be parasitic only on coccinellids, which must have been among the *Pseudococcus*. It is therefore an injurious species.

12. *Pachyneuron* sp.?—From *Pseudococcus yuccæ* on pomegranate, San Luis Potosi. From *Pseudococcus yuccæ* on Agave, Guadalajara.

13. *Pachyneuron* sp.?—Bred from *Acanthococcus* n. sp.? on unknown shrub at Valles (Tamaulipas).

14. *Tribolium confusum* Duv.—From *Acanthococcus* n. sp.? Valles.

15. *Vedalia sieboldii* Muls. var.—This species was found among the waxy egg masses of *Icerya purchasi* which I collected in Magdalena, Sonora. It is a small beetle 3 mm. long, black and red in color; all red below and black above, with two large reddish spots on each elytron, one marginal and the other discal. According to Mr. Schwarz, it is a true Vedalia, whereas *V. cardinalis* (the Australian importation) is not a true Vedalia; Mr. Schwarz thinks there is no reason why *V. sieboldii* should not flourish north of Mexico in the Sonoran belt, and its importation into California might be of much benefit. Unfortunately, it was not found in the egg masses until after my return from Sonora, and it was not met with elsewhere on the trip.

16. *Ozya orbigera* Muls.—This is a bluish coccinellid, considerably smaller than Chilocorus. It was found plentifully in Monterey preying on coccids. The large white cottony-covered larvæ of this species were found with *Lecanium hesperidum* on leaves, branches, and trunk of large trees called "fitolaca," in Monterey. Many adults also occurred on same trees. The larvæ are covered with an abundance of cottony-white excretion, with filamentous processes, and strongly resemble specimens of *Icerya ægyptiaca*. Larvæ numerous, October 17.

17. *Scymnus* n. sp. near *americanus* Muls.—Feeding on *Chionaspis citri* on orange. Tampico.

18. *Scymnus* n. sp. near *auritulus*.—Feeding on *Acanthococcus* n. sp.? Valles (Tamaulipas).

19. *Scymnus* sp.?—Larvæ feeding on *Lecanium oleæ* on orange. San Luis Potosi. A pteromalid, doubtfully belonging to the genus *Arthrolytus*, was bred from one of these scymnid larvæ.

20. *Chilocorus cacti* L.—Preying on *Pseudococcus yuccæ* on agave, etc., Guadalajara; on *Icerya purchasi* on orange, in Monterey. Found in most places devouring coccids.

21. *Tabanus punctifer* O. S.—An interesting observation was made in Magdalena, Sonora. On the white masses of *Icerya purchasi* on orange there were found numerous specimens of *T. punctifer*, all males, busily engaged apparently in piercing the Iceryæ and sucking their juices. I do not know that any similar observation has ever been recorded. There was also among them a single male of another, smaller species of Tabanus (presumably this genus), but it escaped capture.

It is not unlikely that the males of several species of Tabanidæ may prove of much good in destroying Icerya and kindred coccids. *T. punctifer* is found throughout the southwestern region, and it will be interesting to know if the male has the same habit in California.

22. *Leucopis bellula* Willist.—Bred from *Eriococcus dubius* Valles (State of Tamaulipas).

23. *Phora coccidphila* Coq.—Specimens of a fly of the family Phoridæ were bred from *Icerya purchasi* collected on orange both from Monterey and Victoria. It is probably a true parasite, though this can not be said positively.

24. *Dakruma coccidivora* Comst.?—Larvæ feeding on *Acanthococcus* n. sp.? on unknown plant. Valles (Tamaulipas).

25. *Chrysopa* sp.—Victoria, October 16. Larva found preying on *Icerya purchasi* on orange.

26. *Chrysopa* sp.?—Monterey, October 17. Attacking *Icerya purchasi*.

27. *Psocus* sp.?—Found eating *Aspidiotus* n. sp.? (related to *A. perseæ* and *A. fodiens*) on orange. Victoria, October 16.

NOTE.—At Guaymas and Hermosillo, in Sonora, *Vedalia cardinalis* is well known by reputation. I am informed that Don Luis Torres, governor of Sonora, brought the Vedalia to Hermosillo from Los Angeles, Cal., in 1893. Specimens were taken in June, 1894, to Aranjuez, near Guaymas, and placed on the five or six Icerya-infested orange trees on that place. They seem to have done their work well at Aranjuez, for all the Iceryas I found there seemed to be dead and empty. They ought now to be well distributed by the authorities in Magdalena (where there are many thriving colonies of Icerya), and in Victoria and Monterey.

INJURIOUS INSECTS OTHER THAN COCCIDS.

Material was collected on the trip that does not appear below, as only species of economic importance are mentioned.

1. *Aleyrodes corni* Hald.?—Specimens of this species were found on leaves of orange in Guadalajara; and on orange, lime, and Catalpa leaves in San Luis Potosi.

2. *Aleyrodes* sp.?—On leaves of orange, Tampico.

3. *Aleyrodes* sp.?—On leaves of *Tecoma stans*, Guaymas.

4. *Aphides*.—Plant lice often occur on orange in Sonora and other parts of Mexico. They were mentioned as injurious in Guaymas in summer months.

5. *Cicada* sp.—Apple twigs at Magdalena, Sonora, showed unmistakable signs of having been largely oviposited in by a *Cicada*. The same was observed in twigs of deciduous fruit trees at San Ignacio.

6. *Œcanthus niveus* Serv.—Found at San Ignacio, Sonora, September 26, on tobacco. Reported to have caused much injury in August (1894) by eating holes in the tobacco leaves in this district.

7. *Papilio cresphontes* Cram. (?) (orange dog).—An orange dog, the larva probably of this *Papilio*, was found on orange, eating the leaves, in Guadalajara. It was also found on orange in Victoria and Monterey.

8. *Thyridopteryx* sp.?—A bagworm, apparently of this genus, is very bad on orange in parts of Mexico. It was found on orange at Guaymas, where I was told it caused much injury in midsummer. It also occurs on the orange trees in Hermosillo. It was found in large numbers on the orange trees in Guadalajara, and was also found on orange in Tampico.

9. *Ligyrus ruginasus* Lec.—Great numbers of these beetles were observed attracted to light at night at Magdalena, September 26. Also at Nogales (on border). These immense numbers indicate much injury, in case they breed in roots of any crop. It is possible the larvæ breed in *Helianthus*, though it is very likely that they infest roots of sugar-cane which is grown in the Magdalena region.

10. *Oncideres putator* Thom.—This grayish species was found girdling branches of Acacia, near Chocoy (State of Tamaulipas), October 15. It is not improbable that it may attack fruit trees also.

11. *Trypeta ludens* Lw.? (orange worm or maggot).—The oranges which come from the State of Morelos to Mexico City are badly infested with maggots. These are with little doubt the larvæ of this fly, which is fully treated of in Insect Life (vol. I, p. 45). These wormy oranges come principally from Yautepec. So far this orange maggot does not seem to have spread to the other orange regions of Mexico.

NOTE.—*Succinea brevis* Dkr. and *Praticolella griseola* Pfr.—These two species of snails were found on branches and trunks of orange trees in Tampico. The several specimens of *S. brevis* had all been infested with a sarcophagid fly, belonging to the genus *Sarcophilodes*.

Enemies of stored vegetable products.—An effort was made to obtain specimens of certain enemies of grain and other stored products in Mexico. Several species belonging to the Ptinidæ, Bruchidæ, Rhynchophora, and Lepidoptera, are of much economic importance from the injury they would do if introduced into the United States.

A number of species were obtained in stored corn, etc.[1]

EXTENT OF CLIMATIC AND FRUIT REGIONS.

In the region of the western coast of Mexico the warmer belt adapted to the subtropical fruits extends much farther north than it does in the eastern coast region at the same elevation above the sea.

Date palms grow luxuriantly at Guaymas and Hermosillo, and even as far north as Magdalena in Sonora. They can not do well in Chihuahua, which is nearly as far south as Guaymas, nor even in Aguas Calientes, which is well within the tropics. The latter place, though only about 6,000 feet above the sea, has been known to receive snow falls. Magdalena, in Sonora, though but little south of 31° N., is nearly the same temperature as (or warmer than) Monterey, which is about the same distance south of 26° N., and both places are at nearly the same elevation. This represents a difference of 300 miles in a north and south line. Date palms grow well at Matamoras, however, which is near the coast and much farther south than the Sonora date-producing region.

Oranges grow and produce exceedingly well at Guaymas (San Jose de Guaymas) and Hermosillo. They also seem to do fairly well at Magdalena, though there are very few at that place. There are more at San Ignacio, a small town about six miles north of Magdalena on the railroad. The Hermosillo oranges have the reputation of being among the finest in the world. In Chihuahua (neighborhood of city) oranges cannot be raised, the winter frosts being too severe. A few trees are to be found in the city, but only in sheltered patios (interior courts of houses), and none in any of the plazas. A very few oranges are raised at Aguas Calientes. At Monterey some few are raised, and south toward Victoria there is quite an extensive orange-producing region, notably at Montemorelos and Linares, particularly the former. Oranges, and especially limes, are raised at Victoria, and all the region between that place and Tampico would form a splendid district for the production of citrus fruits if a sufficient water supply could be secured. In the Guadalajara region a good many oranges are raised in the barrancas (deep ravines) to the west, but they are extensively produced in the Lake Chapala region south of La Barca, which is less than halfway between Guadalajara and Irapuato, on the main line of the Mexican Central Railroad. Then again, in the State of Morelos, south of the City of Mexico, in the low valleys or hot lands, oranges are raised prin-

[1] These are reported upon by Mr. Chittenden in a following article.—L. O. H.

cipally at Yautepec. In the State of Vera Cruz there is an extensive, well-known orange region in the vicinity of Orizaba and Cordova, as well as farther south. Oranges are also grown to a limited extent in east central Coahuila, and do very well at Matamoras.

Bananas grow outside at Guaymas on the west, and Victoria to Matamoras on the east. They grow only in sheltered patios at Monterey. Plantains, however, are grown outside in towns of northeastern Coahuila, where the frost kills the tops in the winter, but does not injure the roots. Bananas grow and fruit in the barrancas to the west of Guadalajara, between Yautepec and Jojutla in Morelos, and in the Orizaba and Cordova region. They do not grow or fruit on the table-lands.

Cocoanut palms can grow and survive at Guaymas, as Mr. Graf has demonstrated, while Tampico is close to the northern limit for them on the Gulf of Mexico coast.

Sugar cane is grown in southern Sonora (in the Hermosillo region), and some is grown near Magdalena. To the east it is grown from eastern Coahuila to Matamoras. It is extensively raised farther south, in the States of Morelos, Vera Cruz, etc.

Cotton is raised near Santa Rosa, in southern Sonora; near Santa Rosalia and Jimenez, in southern Chihuahua; very largely in what is known as the Laguna district, comprising the region around Lerdo and Torreon, being in northeastern Durango and southwestern Coahuila. Another cotton section of considerable importance is that in northeastern Coahuila, along the International Railroad, between Monclova on the south and Ciudad Porfirio Diaz on the border. Cotton is also raised around Matamoras, and the cotton belt extends into northern Texas.

Corn, beans, etc., are raised more or less all over Mexico. Wheat is largely raised in the Magdalena (Sonora) region, and northeastern Coahuila is well adapted to wheat raising.

Pomegranates are extensively raised in the Magdalena region, especially at San Ignacio, etc.; also some at Hermosillo and Guaymas. They also grow at Monterey, San Luis Potosi, and Matamoras.

Olives grow well at Hermosillo. The olive is grown as a tree in plazas in Chihuahua, but probably does not fruit.

Grapes produce but little in Guaymas, Hermosillo, and Magdalena. Some 20 miles to the west of Chihuahua City there are fruit ranches where considerable quantities of grapes are raised. Some are raised also at Santa Rosalia.

Peaches and pears grow well in the Magdalena (Sonora) region, along the railroad from Cerro Blanco (or Imuris) on the north to Santa Ana on the south. Peaches bear especially well at San Ignacio. They do not seem to do well as far south as Hermosillo. At the ranches west of Chihuahua City they are quite extensively produced. Plums and apricots also do well at Magdalena. Peaches are grown at Santa Rosa-

lia and at Saltillo; also somewhat at Monterey. Apples do not do particularly well in Sonora, the few trees in the Magdalena region failing to yield profitably. Some apples are raised at Saltillo and Monterey, but they are the small Mexican variety. Some few peaches and small apples are also raised in northeastern Coahuila. Peaches, plums, and grapes are said to do well from Nuevo Laredo to Matamoras.

Figs grow luxuriantly at San Ignacio (Sonora), at Monterey, and in towns of northeastern Coahuila.

Quinces are largely grown at San Ignacio and other points in the vicinity of Magdalena, and yield well.

PARTICULARS AS TO PRESENT SHIPPING OF FRUITS, ETC., BY RAIL.

Oranges are shipped from Guaymas and Hermosillo, in Sonora. Those shipped from Guaymas are brought to the railroad at Batamotal, which is a station about seven miles north of Guaymas by rail. These Sonora oranges go to Chicago and other eastern points chiefly, but I was also informed by officials of the Sonora Railway that some are shipped to California, going to the San Francisco market. My investigations in Sonora did not reveal any other scale on orange beside *Icerya purchasi*, and that was long ago established in California, whence it probably spread into Sonora. *Icerya palmeri* was found near Guaymas on grape, but I was unable to find any sign of it on grape or other plant anywhere in Sonora or elsewhere. If it should spread, there would then be danger from these shipments of Sonora oranges of its reaching California, though it probably is so closely related to *I. purchasi* (the young only being known) that I think the prediction is safe that it would practically amount only to a new installment of that species.

In the vicinity of Aguas Calientes, which is on the Mexican Central Railway, a very few oranges are raised. These are shipped only as far as Zacatecas.

On the branch of the International Railway, which runs from Mexico City south into the State of Morelos, oranges are raised in considerable quantity at Yautepec. They are shipped only as far as Mexico City. These Morelos oranges are badly infested with the larvæ of a fly (*Trypeta ludens*). I was informed in Mexico City that it was rare to find an orange entirely free from these maggots. Oranges appearing perfectly sound on the outside prove wormy upon being opened, so that it is impossible to tell infested fruit from its outward appearance. A very few oranges are also raised at Tlalcotapan, Jojutla, and other Indian towns in Morelos on the railway. None of them, however, are shipped farther than Mexico City.

Oranges from the Guadalajara region are shipped principally at La Barca. From Guadalajara itself only about 15 or 20 carloads are shipped yearly. These come from the barrancas to the west, the nearest orange groves being from 20 to 25 leagues from Guadalajara. The groves at La Barca are something like three leagues from the rail-

road. Many carloads have been shipped yearly from La Barca for a period of many years. This is where the largest shipments of Mexican oranges come from, and they are nearly all sent through (in carloads) to Kansas City.

In the State of Tamaulipas, oranges are shipped largely from Montemorelos, and also largely though in less quantity from Linares, both on the Monterey and Gulf Railway, between Monterey and Victoria. These also are all shipped to Kansas City, and doubtless go over the National Railway via Laredo and San Antonio. Some few are shipped from Victoria. Very few oranges are raised at Tampico, and therefore none shipped.

The Cordova and adjacent orange regions do not ship fruit out of the Republic. It is consumed mostly between Mexico City and Vera Cruz. An occasional tourist may, however, bring oranges from that region to the States.

Limes are raised at Guaymas, but none or very few are shipped, though I should think it would pay well to ship them. They are produced in great quantity in Tamaulipas, notably at Victoria, and their shipment would, I believe, be profitable. It is because such shipments may be made in the near future that these points are mentioned.

Peaches, pears, and quinces are shipped in some quantity from the Magdalena (Sonora) district to Arizona points chiefly. No pests, however, were found on these fruits. Pomegranates are shipped from Magdalena and Hermosillo to Arizona points. Watermelons are shipped from Sonora to Arizona points and to Albuquerque and Deming in New Mexico. Wheat, corn, beans, etc., are not shipped, as a rule, but are all consumed in the country. Irish potatoes are usually scarce.

STEAMSHIP LINES AND THEIR BEARING ON THE SUBJECT.

As affecting the dispersion of orange pests, as well as scale insects in general, it should be mentioned that at present West Indian and Pacific Company steamers ply regularly between Tampico and New Orleans, stopping at Progreso on the way. They arrive at Tampico from Kingston, Jamaica, with a stop at Vera Cruz included; and they arrive at Jamaica from Colon. It should be remembered, however, that during all the warmer months these steamers are rigidly quarantined below New Orleans and everything aboard thoroughly subjected to the influence of hot steam or fumigated. It is not likely that the scale insects would survive the treatment to which the New Orleans authorities subject all boats that arrive during the warmer months from so-called yellow fever ports, but scales could easily be brought during the winter months.

Steamers also run from Tampico to Galveston and Mobile, while the Ward Line boats, that run to New York from Tampico, arrive at the latter port via Habana and Vera Cruz.

On the west coast regular steamers ply between all ports and San

Francisco, but these are quarantined and inspected in California by horticultural inspectors, so that not much is to be feared from that quarter. More is to be feared from the Gulf of Mexico coast lines and railway communication.

DANGER FROM WEST INDIAN PORTS.

Our Southern States stand in much danger from West Indian ports, especially from Cuba, which is in close communication with them by steamships and sailing vessels. Sixty-five or more species of scales are known from Jamaica. Seventeen of these occur out of doors in the Southern States, eight more being known in hot-houses there. Only four species of scales are so far recorded from Cuba. Compared with Jamaica, Cuba ought to have 75 or 100 species. Many species have doubtless been brought from Cuba to our Southern States, and others are apt to follow if not guarded against. Frequent boats run from Tampa, Fla., to Key West and Habana, and return by same route. It is only 90 miles across from Key West to Habana. Frequent boats run from Cuba to other ports in the Southern States.

CONDITIONS WHICH RETARD THE SPREAD OF INJURIOUS INSECTS IN MEXICO.

It is a peculiar fact that in Mexico the natural conditions are such as to retard the spread of injurious insects of certain groups; while, on the other hand, artificial conditions that spread insects in our own country are happily such at present as to give little aid to their dispersion in Mexico. I refer, first, to the topography and resultant isolation of climatic regions in Mexico; and second, to the fact that shipments of fruit, etc., by rail are not made from one to the other of these regions These observations apply best to orange insects. The following is a good case in point:

It has already been mentioned that the orange worm (larva of *Trypeta ludens*) infests the oranges to a very great extent in the State of Morelos. It was known in that region many years ago, and does not seem to occur yet in any other orange region. Inquiries were made at Guadalajara, where I was told that wormy oranges were unknown, and I have never known of wormy oranges from the Cordova or Orizaba region, many of which I have examined. Likewise they were not heard of in Tamaulipas or Sonora. The explanation of this is that the Morelos orange region is effectually isolated from others by climatic barriers in the shape of ranges upon ranges of mountains where the orange can not thrive, even were these ranges not in the original wild state, and also that the oranges shipped from the infested localities in the State of Morelos go no farther than Mexico City, where they are all sold and consumed.

The same holds good in several instances of scale insects of the orange. *Orthezia insignis* var. was found only in Guadalajara and

Aguas Calientes. It was very bad at both places. These two localities are connected by deep and long barrancas, which run in a somewhat northeasterly and southwesterly direction a little to the west of both places, and in which oranges are largely raised. Both localities, therefore, belong to the same region. Either this or a similar variety, however, is known from Vera Cruz.

Pseudococcus yuccæ is an exception, as it occurs from Morelos (State) to Guadalajara and Tampico, and is spread well over the plateau region, even extending into California. It is a much hardier insect.

Aspidiotus scutiformis was originally found by Cockerell at Soledad, in the State of Vera Cruz, on leaves of a tree resembling avocado pear somewhat. Doubtless this tree is its native food-plant, or one of them, and this would indicate that the species had taken to orange and spread northward. This it could easily do, as there are no mountain ranges to act as barriers to its spread to the northward. The Gulf Coast region is a low, flat strip of country, from 50 to more than 100 miles in width, between the Gulf and the foothills of the mountains, and running from southern Vera Cruz State to Texas, gradually widening to the northward. Though this species was not met with at Tampico, it must occur in that vicinity, as it was found so abundant at Victoria and as far north as Monterey. It has so far been found only in the foothill regions of the eastern side on the Mexican table-land, in localities between 1,000 and 2,000 feet in elevation. It is very likely to turn up, however, at any time in Tampico and Matamoras.

Icerya purchasi is a more difficult case to explain, being found in Sonora on the west and in Tamaulipas and Nuevo Leon on the east. These two regions are separated not only by a vast tract of high table-land, but by the vast and almost unknown region of the Sierra Madre Mountains, and are totally unconnected by either railways or wagon roads, except in a roundabout way through the United States. It seems impossible that it should have spread from one region to the other, unless by means of cuttings sent from the Sonora region. It is more probable that it spread to the eastern region by cuttings brought from California.

SCALES THAT HAVE BEEN INTRODUCED INTO MEXICO FROM THE UNITED STATES.

Turning now from the importation side of the question and looking at the exportation side, there is little doubt that Mexico has received several noxious species of scale insects from the United States through her steamship communication with the Southern States. *Chionaspis citri*, *Mytilaspis gloveri*, and *Aspidiotus ficus* were found plentifully in Tampico and (except the first) in Brownsville and Matamoras, but not elsewhere, except that the last was found by Cockerell in Vera Cruz. They have doubtless been brought to these ports by steamers from Mobile and New Orleans. *A. ficus* is abundant in Jamaica, and may have been brought

from there, however, or from Cuba. Steamers from both islands stop at Vera Cruz before reaching Tampico, and this would explain the occurrence of *A. ficus* in Vera Cruz.

As to railway introductions, *Icerya purchasi* has probably been brought to Sonora from California in this way. It was most abundant at Magdalena, less so at Hermosillo, and still less at Guaymas. I was informed by Señor U. Ferreira that it first appeared in Hermosillo during the yellow fever epidemic there eleven years ago, in 1882–83. It was first noticed in the plaza. The railway had recently been completed at that time. I do not see how else it could have reached Sonora from California than on orange cuttings. It is found in the interior of Tamaulipas (but not at Tampico), and in Nuevo Leon, and the most probable theory is that it spread to both regions in Mexico directly from California on cuttings.

SCALE INSECTS MOST LIKELY TO BE INTRODUCED INTO THE SOUTHERN UNITED STATES FROM MEXICO, AND MOST TO BE FEARED.

Aspidiotus scutiformis.—This is a very bad species, and is apt to reach the Southern States or California. Its northern limit, as at present known, is Monterey, where it is simply massed upon the leaves of the orange. It would most probably spread by rail, as it does not seem to be found at Tampico. It may be expected at any time in Matamoras and Brownsville (Texas).

Pseudococcus yuccæ.—This is another very bad species, being particularly bad on orange at Guadalajara. It was originally described from California, but there is much danger of its reaching the Southern States from Mexico. It infests a great variety of plants, is a hardy species, and is well spread over Mexico. Therefore it would be extremely apt to adapt itself readily to the Southern States, and should it reach there it would prove a most unwelcome pest. It would probably spread by rail, though there is also a probability of its being carried by boats from Tampico.

Orthezia insignis var.—This would prove, if anything, worse than either of the two preceding. It is very injurious on citrus fruits in the Guadalajara and Aguas Calientes region. It would probably spread by rail. Professor Cockerell informs me that this species has recently been sent him by Dugès from Guanajuato, which proves that it is beginning to spread. If the variety found in Vera Cruz by Cockerell is the same, it is already spread over a wide region in Mexico.

Icerya palmeri.—This species could not be found in Sonora by the writer. If it should spread, it would stand a very good chance of reaching California by rail.

Aspidiotus articulatus.—This was found on orange in Tampico, associated with *A. ficus*. It could easily reach the Southern States by boats.

Several other species, including *Conchaspis angræci* var. *hibisci* found

at Tampico, would doubtless prove very injurious, at least to certain ornamental trees and plants, if introduced. It should also be remembered that *Chionaspis citri*, *Mytilaspis gloveri*, and *Aspidiotus ficus* have not reached California, but may do so through Mexico; just as *Pseudococcus yuccæ*, which occurred in California, may reach the Southern States from Mexico.

DANGER TO MEXICO FROM INTRODUCTIONS FROM OUR COUNTRY.

There are a number of scales of the orange in California that are not yet known in Mexico. These could easily reach the Hermosillo and Guaymas orange districts of Sonora by rail. Sonora, on the whole, probably stands in more danger from us than we do from her.

Again, there are several bad species in our Southern States that have not yet reached Mexico, and which could easily do so on board steamers plying between New Orleans, Mobile, and Mexican ports.

NATURAL ENEMIES OF SCALE INSECTS IN MEXICO DESIRABLE TO COLONIZE IN THE UNITED STATES.

Among the Coleoptera, it would be very desirable to introduce *Vedalia sieboldii* var., *Ozya orbigera*, and the species of *Scymnus* mentioned; nearly all of the parasitic hymenoptera (except *Homalotylus*)—about 14 species mentioned, of which probably but few occur within our limits—and the *Phora cocciphila* bred from *Icerya* from Monterey and Victoria.

AGENCIES NOT GENERALLY RECOGNIZED IN THE DISPERSION OF SCALE INSECTS.

Tourists who visit Mexico often bring away with them specimens of live plants, etc. In this way they may play a greater part in the dispersion of scale insects than do fruit shippers. Much is to be feared from this source, which is doubtless responsible for many introductions. It is more often practiced on steamers than on railroads. On the steamers which ply between different islands in the West Indies there are almost always to be seen potted and other plants which passengers are taking home with them from some other island. In this way it is believed by Professor Cockerell that many of the noxious scales found throughout the West Indies have been spread from one island to another.

PORTS AND POINTS ON THE BORDER MOST TO BE GUARDED.

The Pacific ports of Mexico are supposed to be well guarded against by the horticultural inspectors in California, as already mentioned. The ports of our Southern States are open, at least during the colder season, to importations of injurious scales from the Gulf ports of Mexico and the West Indies. Inspection should be instituted of all plants, fruits,

roots, seeds, grains, and other vegetable products reaching these ports—Galveston, Corpus Christi, New Orleans, Mobile, Tampa, Key West, and Brazos (port of Brownsville).

Border points between the United States and Mexico where most is to be feared are those situated on the railroads. They are five in number: Nogales (in Sonora and Arizona), Ciudad Juarez (opposite El Paso, Tex.), Ciudad Porfirio Diaz (opposite Eagle Pass, Tex.), Nuevo Laredo (opposite Laredo, Tex.), and Matamoras (opposite Brownsville, Tex.). These are, respectively, on the Santa Fe (or Sonora) Railway, the Mexican Central, the Mexican International, the Mexican National, and the Matamoras and Monterey, along the Mexican side of the lower Rio Grande, bought by the Mexican National Railway Company to prevent (or delay as long as possible) its completion. This last-named line runs from Matamoras to San Miguel, connecting there with stage for Monterey; at the other end it connects with a short line, the Rio Grande Railway, running from Brownsville to Point Isabel (across the bay from Brazos de Santiago), on the Texas coast.

All plants, fruits, stored grain, roots, and vegetable products of any description coming from Mexico should be inspected before they are allowed to cross the border into the United States. In all cases especially careful inspection should be made of living plants or roots, potted or otherwise, when such occur.

INSECTS AFFECTING STORED CEREAL AND OTHER PRODUCTS IN MEXICO.

By F. H. Chittenden.

The warm, equable climate of Mexico, particularly of its tropical portions, where insects breed continuously the year round, is particularly adapted to the existence of such species as subsist on grain and other edible products that are kept in store, a fact that was brought prominently to view by the collections of the writer in the exhibits of that country displayed at the World's Columbian Exposition.

Toward the close of Mr. Townsend's tour of investigation in Mexico he was requested by Mr. Howard to collect such insects as might be found in stored cereal and other edible seeds and similar products, but owing to the then limited time at Mr. Townsend's disposal and the further fact that only a few localities were visited nothing new or especially interesting was taken, all the species reared from samples of his collecting being common and of cosmopolitan distribution.

The grain and seed display of Mexico was one of the largest on the Exposition grounds, and as the numerous samples came from many parts of that country an exceptionally fine opportunity was afforded for the collection of the native and injurious forms.

A greater number of insects were present in these exhibits than from any other country, and all of the really dangerous species were found in them (see author's report, Insect Life, vol. VI, p. 225). Several of these insects are unknown or of limited distribution in the United States, and it seems fitting that a list of such as infest stored edible products be brought together as a supplement to the lists of other Mexican insects prepared by Mr. Townsend. I have included a few data gathered from collections at the Atlanta Exposition of 1895, and have added brief notes on their food habits, injuriousness, and distribution, and have indicated the species whose introduction into our storehouses are especially to be guarded against.

The cosmopolitan species of wide distribution in the United States are marked with a star (*).

LIST OF MEXICAN INSECTS THAT AFFECT STORED PRODUCTS.

* *Silvanus surinamensis* Linn. (saw-toothed grain beetle).—A common cosmopolitan and widely distributed species, found in various Mexican exhibits at the Columbian Exposition by the writer and in shelled corn sent to this office by Mr. Townsend. It is injurious to a great variety of cereal and other seeds, dried fruits, and many other substances.

Silvanus sp.—An undetermined species found in yams and edible tubers in the Mexican exhibit at the Exposition.

* *Cathartus advena* Waltl.—Also taken at the Exposition. A widely distributed general feeder like *S. surinamensis*, but not so common or injurious.

Pharaxonotha kirschi Reit.—This species was originally described from Mexico, and was found in the Mexican and Guatemalan exhibits of the Exposition, infesting corn meal and edible tubers. Sufficient material was secured for rearing and other experiment, and my experience with this insect indicates its ability to hold its own with the other tropical species that have already been introduced here. Its occurrence has been noted in Brazil, where it may be native, as well as in tropical Central America.

Until December of 1895, when Mr. E. A. Schwarz captured a single individual of this insect in the vicinity of San Antonio, Tex., it had never been taken in this country. It was found under dried leaves remote from human habitation. Although this shows that the species occurs within our faunal limits, it was probably imported across the Mexican border, and there is still danger of its introduction into storehouses through commerce with Mexico, and especially since it is not confined for food either to meal or tubers.

Litargus sp.—A mycetophagid closely allied to our native *L. balteatus* Lec., breeding in abundance in potatoes, yams, and other edible tubers at the World's Fair. None of the species of this genus are known to be injurious, and it is probably only a scavenger.

* *Tenebroides mauritanicus* Linn. (cadelle).—A common species of omnivorous habits, but chiefly injurious to cereals; probably indigenous to tropical America, but long ago diffused by commerce over nearly the entire globe.

* *Carpophilus hemipterus* Linn.—An enemy of stored fruits. Recorded by Dr. Sharp from Cordova and Jalapa.

Carpophilus pallipennis Say (corn sap-beetle).—Collected by Dr. Edw. Palmer and the late H. K. Morrison in Mexico. Sometimes injurious to stored corn in our Southern States.

* *Carpophilus dimidiatus* Fab.—Taken in numbers in corn meal at the Columbian Exposition by the writer. Widely distributed in Mexico. Lives in cotton bolls and in ripening or overripe fruit in the South.

* *Dermestes vulpinus* Fab. (leather beetle).—Living on hides and dried fish in the Mexican exhibit at the Exposition. Also in the National Museum from another source in Mexico.

Dermestes carnivorus Fab. (*mucoreus* Lec.).—Of similar habits to the preceding, and said to injure bacon and hams after the manner of that species. Recorded from Mexico and from Texas. Nearly cosmopolitan.

* *Necrobia ruficollis* Fab. (red-necked ham beetle).—Recorded from Guanajuato by Gorham. Taken on dried fish at the Exposition.

* *Necrobia rufipes* Fab. (red-legged ham beetle).—Recorded from several localities in Mexico by Gorham. Taken with the above. Also infesting cheese.

Dinoderus truncatus Horn.—This species was first recorded by the writer from Mexico (Insect Life, vol. VII, p. 327) from specimens found infesting corn and edible tubers at the Columbian Exposition. It was found in corn in the Mexican exhibit at the New Orleans Exposition; also in samples of Mexican seed corn in the Botanical Division of this Department. This is an aggressive species and will bear close watching. It is able to subsist on almost any sort of roots and tubers, and would create great havoc should it become introduced into our granaries, as the adult has a habit of leaving the grain in which it has bred and boring into woodwork or anything else that obstructs its path. I have known it to bore into both pine and hard black walnut. Described from California from mutilated material, probably of accidental occurrence as the species has not been recorded from there since.

Dinoderus pusillus Fab.—Recorded from Mexico by Rev. H. S. Gorham, who states that it is "common in wood of sugar casks." It also injures grain. At the Columbian Exposition it occurred in two exhibits from Mexico.

* *Sitodrepa panicea* Linn. (drug-store beetle).—A well-known cosmopolitan species, injurious to cereals and other seeds, drugs, tobacco and other dried plants, and a great variety of dried substances. Recorded from Cordova and Pueblo by Gorham.

* *Lasioderma serricorne* Fab. (*testaceum* Dufts.) (cigarette beetle).—Mentioned by Gorham from Vera Cruz. Of very similar habits to the above, but not so common, and chiefly injurious to tobacco and drugs.

* *Tribolium ferrugineum* Fab. (rust-red flour beetle).—An important enemy of stored cereal and other products, of wide distribution. In the Mexican exhibit at the World's Fair; also recorded from there.

* *Tribolium confusum* Duv. (confused flour beetle).—Mentioned by Dr. Champion as occurring in Mexico, and collected by Mr. Townsend. Of similar habits to the preceding.

* *Echocerus maxillosus* Fab. (slender-horned flour beetle).—This species is probably native to South America and perhaps also to Mexico. Common in our Southern States under bark and in cornfields as well as in the granary.

* *Echocerus* (*Gnathocerus*) *cornutus* Fab. (broad-horned flour beetle).—Champion states that this species has been introduced in Mexico. I am, however, inclined to consider it as not generically distinct from *Echocerus*, and hence, with other species of the genus, as indigenous to the New World. Although cosmopolitan, it is still of limited distribution in the United States, being comparatively unknown outside of California and in the neighborhood of the Atlantic seaboard.

Sitophagus hololeptoides Lap.—This species is related to the preceding and is known to have been found in flour. It is undoubtedly indigenous in Mexico, but is unknown in the United States. As it is probable that it occurs like other allied forms chiefly under bark, its introduction with us would not positively prove disastrous.

Palorus subdepressus Woll.—The flour beetle mentioned by Champion under the name of *Palorus melinus* Hbst. (Biol. Centr. Amer., Col. vol. IV, pt. 1, p. 174) as having been collected by Dr. Edw. Palmer, of this Department, at Minas Viejas, has since been determined by the same writer as the above-mentioned species. It occurs in granaries in Europe and elsewhere, also under bark. In our Southern States it has been found, but only under bark.

* *Tenebrio obscurus* Fab.—Reared from a larva collected in Mexico by Dr. Palmer. The larvæ of this species and *T. molitor* are the familiar "meal-worms" and have probably both been introduced into Mexico as food for song birds.

* *Alphitobius diaperinus* Panz.[1]—Mentioned as occurring in Mexico by Champion. Habits similar to the meal-worms, with which it often occurs. Widely distributed.

* *Alphitobius piceus* Ol.—Also recorded by Champion, who states that he found it (at Panama) "amongst old bones thrown out from the slaughterhouses." Cosmopolitan, but practically limited to the South in the United States.

* *Bruchus obtectus* Say (common bean weevil).—In the greatest abundance in the Mexican exhibit at the Exposition, and sent also by Mr. Townsend. A well-known enemy to beans almost everywhere.

* *Bruchus 4-maculatus* Fab. (four-spotted bean weevil).—A common species in our Southern States and said by Sharp to occur in Mexico.

* *Bruchus* (*chinensis* Linn.) *scutellaris* Fab. (cowpea weevil).—Also recorded by Sharp from Mexico.

Spermophagus pectoralis Shp.—This species, as I have already pointed out (Insect Life, vol. VII, p. 328), breeds like our common *Bruchus obtectus* in stored beans, and as it is congeneric with other species belonging to our United States fauna its introduction into this country in beans should be avoided. It was originally described from Central America and was breeding at the Exposition in beans from Brazil, as well as from Mexico and Guatemala.

* *Calandra granaria* Linn. (granary weevil).—In grain and chick-peas collected by the writer at the Exposition and by Mr. Townsend in Mexico.

Calandra oryza Linn. (rice weevil).—This species attacks all sorts of cereals and is as well distributed and injurious probably as any known insect. It was present in injurious numbers in nearly every grain exhibit at the Columbian Exposition, and has been sent us by Mr. Townsend and others from different parts of Mexico.

Caulophilus latinasus Say.—This little cossonine weevil, which bears some slight

resemblance to the two preceding species, was received at this office in December, 1895, from the Atlanta Exposition, where it was found in Indian corn and chick-peas (*Cicer arietinum*) in the Mexican exhibit. So far as we know, this is the first instance of its occurrence in either stored grain or legumes, although there is one record, by Mr. Townsend, of its having been found in dried ginger in Jamaica (Institute of Jamaica, Notes from the Museum, No. 78). Occurs in Florida and South Carolina, but does not seem to be known with us as a storehouse pest.

Araecerus[1] *fasciculatus* DeG. (coffee-bean weevil).—A series of this anthribid beetle was collected by Dr. Palmer at Acapulco. It is disposed to omnivorousness, being known to breed in raw coffee berries, cacao beans, mace, nutmegs, cotton bolls, the seed pods of the coffee weed (*Cassia* sp.), and a plant called wild indigo, probably a species of *Indigofera*. This insect is already well known throughout the cotton States, and beetles are sometimes found in the Northern States in articles of commerce.

Cryphalus jalappæ Letz.—This little scolytid borer is probably indigenous to Mexico, but is often imported into other countries with commercial jalap, upon which it lives. Its presence is not considered detrimental to the drug.

* *Sitotroga* (*Gelechia*) *cerealella* Ol. (Angoumois grain moth).—This species is a powerful rival of the two Calandras as a granary pest. Like them, it thrives on cereals of all kinds and is nearly as well distributed. At the Columbian and Atlanta Expositions, and collected by Mr. Townsend and others.

Ephestia kuehniella (Mediterranean flour moth).—This scourge of the flour mill was breeding in a large exhibition case from Mexico at the Exposition, but the colony was promptly destroyed and the introduction of the species at Chicago thereby prevented. It has obtained a footing in several portions of the United States, being particularly destructive on the Pacific Coast, but in the East and the South it is still very limited in its distribution, and its introduction through Mexico into Texas and other Southern States is more to be dreaded than that of any other storehouse insect.

* *Plodia interpunctella* Hbn. (Indian-meal moth).—A wide-spread species, of omnivorous habit. In grain and dried fruits from Mexico both in the agricultural and horticultural buildings at the World's Fair. It was reared from cacao beans from Mexico, and from edible acorns collected in Chihuahua by Mr. Townsend.

* *Tinea biselliella* Hum. (clothes moth).—A series of this moth has been received from Dr. E. Dugès, Guanajuato, Mexico, with the statement that the insect does much damage to stored corn. The species has in this instance, perhaps, been confounded with *Sitotroga cerealella*, although I have myself reared it from stored wheat infested with the latter insect.

Carphoxera ptelearia Riley (herbarium geometer).—This pernicious herbarium pest was described from material first found infesting dried plants received at this Department from Mexico and Lower California, and it is more than probable that these insects were introduced from that country.

* *Piophila casei* Linn. (cheese skipper).—At the Columbian Exposition in cheese; also injures ham.

Atropos sp.—In the Mexican exhibit at the World's Fair.

Gamasus spp.—Two undetermined mites of this genus, with the preceding in corn.

In addition to the above, a few other species not positively known to occur in Mexico should receive at least passing mention here, as there can be little doubt, from what is known of their distribution, that they occur in that country. These are: *Cathartus gemellatus*, the "red grain beetle" of our Southern States; *Ephestia elutella*, or chocolate moth; *Anthrenus verbasci* (*varius*), a common museum pest; *Trogoderma sternale* Jayne, a species of somewhat similar habits to the preceding one; *Calandra linearis*, the tamarind-seed weevil; *Alphitophagus bifasciatus*, a cosmopolitan species often found in storehouses.

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[1] *Araecerus* is the original spelling of this genus (Schoenherr's Curc. Disp. Meth., p. 40; Gen. et Sp. Curc., vol. I, p. 173), hence must take precedence over *Araeocerus*.

[2] During April, while this bulletin was going through the press, the discovery of the flour moth was announced in a mill near Saltillo, Mexico.

NOTES AND DESCRIPTIONS OF THE NEW COCCIDÆ COLLECTED IN MEXICO BY PROF. C. H. T. TOWNSEND.

By T. D. A. Cockerell,
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ASPIDIOTUS.

The two following new species are both nearctic, not neotropical, types.

Aspidiotus nigropunctatus n. sp.

Female scale.—Subcircular to suboval, 3 mm. in diameter, only slightly convex, crowded together on bark. Color of scale dirty gray. Exuviæ sublateral, pitch-black, with a narrow reddish margin. Exuviæ covered by an easily deciduous film of white secretion. Removed from the bark, the scales leave a conspicuous white mark. Immature scales are rather brownish.

Adult female.—Orange brown, oval. Mouth-parts large. Five groups of ventral glands, cephalolaterals 16 (sometimes more), caudolaterals 10 or 11; median group with 7 or 8 orifices. Anal orifice elongate in form, somewhat posterior to level of caudolateral groups of glands. Four pairs of lobes, these blunt and subtruncate, broad but not very broad, and flattened as in *mimosæ*; median lobes close together but not touching, their proximal sides parallel, their ends squared though rather irregular or subcrenate; second and third lobes distinctly notched; fourth rather low and rounded, with a smaller detached portion cephalad. Cephalad of this, the margin presents three small lobules. Plates not conspicuous, scale-like, short. Between the lobes are saccular incisions, such as are seen in *mimosæ*, etc. These are as follows: A short one at inner base of each median lobe; a large one, followed by a small one, between first and second lobes; a large one, with a small one on each side of it, between the second and third lobes; three rather small ones between the third and fourth lobes. The oval (dorsal) pores are as follows: One beneath each median lobe; four or five beneath (cephalad of) second lobe; a row of about nine beneath third lobe; a row of four or five beneath interval between third and fourth lobes. In a line with the last-mentioned row, but some distance cephalad, is an irregular series of twelve small round pores.

Embryonic larva with conspicuous blue-black eyes.

Habitat.—San Luis Potosi, Mexico, on shrub called "trueno," October 12, 1894. (Townsend No. 13; Div. Ent. Dept. Agr. No. 6442.)

Closely allied to *A. obscurus* Comst., but differs in color of exuviæ, shape of female, and number of orifices in grouped glands.

NOTE—Diagnostic descriptions of these species have been given under the title "Preliminary Diagnoses of New Coccidæ," and published in Supplement to Psyche, February, 1896 (pp. 18–20), in order to secure priority to Mr. Cockerell, the date of issuance of this bulletin being uncertain.—L. O. H.

Aspidiotus townsendi n. sp.

Female scale.—On upper side of leaf, 1 to 1½ mm. in diameter, circular or slightly oval, quite flat, thin, grayish white or rather almost transparent. Exuviæ central or nearly so, covered, round, pale orange, strongly contrasting with scale. First skin placed rather to the side of the second.

Male scale.—Similar but smaller and elongate, with the exuviæ toward one end.

Adult female.—Orange, when boiled in soda becoming colorless, with the terminal portion tinged with brown. Shape subcircular, occasionally reniform. Four groups of ventral glands, cephalolaterals 4 to 8, caudolaterals 5. Anal orifice large, oval, about twice its length from hind end. Two pairs of rounded lobes, median largest, not contiguous. Rounded incisions between the lobes, as in *uvæ*, *ancylus*, *cydoniæ*, etc. Plates forming a scaly fringe in the region of the lobes. Margin cephalad of the lobes, with six spine-like plates, branched at tips, the first (caudad) three the largest. An irregular row of oval dorsal pores some distance from margin of terminal portion.

Habitat.—Ciudad Porfirio Diaz (Piedras Negras), Coahuila, Mexico, November 17, 1894, on leaves of tree with entire or very slightly toothed ovate-lanceolate leaves, 33 to 57 mm. long. (Townsend; Div. Ent. Dept. Agr. No. 6466.)

I am obliged to regard this as a new species, but it is very near to *A. uvæ* Comst., and especially to the "physiological species" *A. coloratus* Ckll., which latter lives on *Chilopsis* in the Mesilla Valley, New Mexico. In *coloratus* both scale and exuviæ are concolorous pale orange brown, whereas in *townsendi* the scale and exuviæ strongly contrast. On superficial examination, the present species might perhaps be confounded with *aurantii*, *articulatus*, or *dictyospermi*, but a microscopical examination at once shows marked differences from any of these.

Aspidiotus yuccæ n. sp.

Female scale.—Small, greatest diameter about 1 mm. or a little over. Oval, moderately convex, dirty whitish, with the covered, inconspicuous, pale brown exuviæ to one end. Exuviæ when rubbed appear shining dark brown or black, very conspicuous. The scales leave a white mark when removed from the plant.

Adult female (boiled in alkali).—Transparent, very pale yellowish, sometimes brownish; mouth-parts and end of body tinged a deeper yel-

low. Shape nearly circular. Lobes dark brown, in strong contrast, appearing purple edged in some lights; margin cephalad of lobes also appearing purple. Three pairs of lobes, all low, the median ones largest, rounded, broad, not contiguous; the other two pairs rudimentary. Three pairs of spine-like plates, i. e., a pair between median lobes and one on each side adjacent to second and third lobes. These plates are conspicuous, sharp, much longer than the lobes. Very small, sac-like incisions between the lobes. A transversely elongate pore beneath space between median lobes and one beneath each second and third lobe. Anal orifice very far posterior, less than its length from hind end. No grouped ventral glands, but as the specimens have neither eggs nor larvæ they are probably not fully mature.

Habitat.—Ciudad Porfirio Diaz, Coahuila, Mexico, November 25, 1894, on a Yucca, doubtfully referred to *Y. australis.* (Townsend; Div. Ent. No. 6465.) Closely allied to *A. bowreyi* Ckll., which occurs on Agave.

Aspidiotus perseæ Comst.

Mr. Arthur de Cima, United States consul at Mazatlan, has been kind enough to send me a piece of cocoanut palm leaf from his garden. On it I find two examples only of an *Aspidiotus*, one too young to do anything with, the other just forming the true scale. Except that the plates are perhaps less branched, the insect agrees with *A. perseæ*, and I can do nothing but refer it thereto.

The following is a description of the specimen:

Female scale.—Diameter about 1 mm., circular, very slightly convex, opaque, reddish brown with the central portion blackish, exuviæ covered. True scale just forming, whitish, but would no doubt become darker with maturity.

Adult female.—Pale orange yellow, subcircular or very broadly pyriform; three pairs of distinct lobes and three others rudimentary. Median lobes small, rounded at ends, parallel sided, nearly as far apart as the width of one; second and third lobes oblique broad, low, finely serrate on their margins; third lobe longer than second, and with more serræ; fourth lobe a little longer than third, very broad and low, with its margin also serrate or finely crenulate; fifth lobe about as long as third, very low. Beyond this, three or four small serrated prominences indicate other rudimetary lobes. A pair of short, spine-like plates between median lobes, a pair between median and second, and also between second and third and third and fourth, those between second and third being somewhat largest of any. Long, sac-like, tubular glands between the lobes, or rather at their bases, those cephalad of second and third lobes being the longest. Numerous transversely oval pores as usual in some species. Four groups of ventral glands, caudolaterals of seven orifices, cephalolaterals of eleven. Anal orifice moderately large, pyriform, slightly caudad of level of caudolateral groups of glands. Surface finely striate.

This is very much like *A. scutiformis* in the characters of the female, but the scale is quite different.

Ceroplastes mexicanus n. sp.

Female.—Waxy scale, 6 mm. long, 5 broad, 3½ high. Wax moderately thin, grayish white with an ochreous tinge, smooth, without noticeable ridges or grooves. The wax is clearly separated into plates, though one has to look closely to see the sutures, which are concolorous with the rest of the wax. Plate nuclei small, dull, dark purplish, with the usual central spot of white secretion. Dorsum of denuded insect simply convex, caudal spine rudimentary. Derm yellowish brown, with round gland spots encircled by a suffused irregular ring of dark brown. Legs ordinary. Coxa with a pair of moderately long bristles at its end. Trochanter with a very long hair—as long as the femur. Femur only about as long as tibia. Tibia about one-third longer than tarsus. Tarsal digitules fairly long and stout, with large suboval knobs. Claw short, curved; digitules of claw stout, with large round knobs distinctly separate from the stalks. Antennæ of the usual lecaniine type, joints very obscure, but there appear to be certainly seven; 4 longest, a little longer than 3; 2 and 1 subequal; the last three shortest and subequal; formula 4, 3 (1, 2) (5, 6, 7); 4 with a very long hair and two short ones at its end; last joint with several hairs, but none nearly so long as that on 4.

Habitat.—San Luis Potosi and Guaymas, Mexico; on *Catalpa* sp., October 12, 1894. (Townsend No. 20= Div. Ent. Dept. Agr. No. 6434.)

In shape and size near to *C. cirripediformis* Comst., but at once separated by superficial appearance alone. It is superficially rather like *C. irregularis* Ckll., but that species is really quite distinct and does not show separate plates.

Coccus cacti L. subsp. **confusus** Ckll.

Habitat.—Near Arroyo, Tex., December 10, 1894, on *Opuntia.* (Townsend; Div. Ent. Dept. Agr. No. 5859.)

In the "American Naturalist" for December, 1893, I published an article on the different species of *Coccus.* Since then two important facts have developed, viz: (1) The antennæ of *C. confusus* are normally 7-jointed, as in the other species; (2) the Jamaican insect is not typical *C. cacti.* The races of *Coccus* now known to me are four in number. It seems preferable to regard them as subspecies of *C. cacti* rather than as distinct species.

(1) *C. cacti* Linn.—This I have seen alive only in Madeira. The females are comparatively large and sparsely covered with mealy secretion. Those I have studied had been purchased for the use of the chemical department of the New Mexico College. They are sold whole and ground down in a mortar to provide the pigment. I was surprised to find that the derm of these was very distinctly reticulate, the reticulations small and equally broad in any direction. The groups of gland orifices were brown, and therefore very conspicuous; the number of orifices in a group variable,

about seven on an average, perhaps. These orifices are considerably larger than in *confusus*. Antennæ as usual in the genus. Legs much larger than in *confusus*; femur stout. Truncate spines very narrow (in the Jamaican insect they are very broad), with some complete spines among them. The insect, flattened under a cover glass, is 5 mm. long and 3 broad.

(2) The Jamaican insect. Secretion profuse, as in *confusus*. Truncate spines thick, as in *tomentosus*. I am inclined to suppose that this may be the variety called "*sylvestre*," but as I have seen no clear description of that form I am in doubt.

(3) *C. tomentosus*. Found in the Guanajuato region of Mexico. The females are not imbedded in profuse secretion as in *confusus*, but are clearly separable, being nevertheless each one enveloped in secretion, and not almost naked as in typical *cacti*. This was supposed to be the "*sylvestre*" = *tomentosus*, by Lichtenstein, who had previously placed it (in MS.) as a new *Acanthococcus*. It appears that he noticed the insect, under the name *tomentosus*, in Bull. Soc. Ent. France, 1884.

Dr. Dugès kindly lent me a letter which Lichtenstein wrote him on July 4, 1884, containing the following passage, freely translated:

"I suppose you note that I have not published the *Opuntia* coccid under the name *Acanthococcus opuntiæ*, for I have found that Lamarck had named 'la Cochenille sylvestre du Mexique' *Coccus tomentosus*. I must use the specific name, though I am not sure that it is the same insect, not yet having been able to consult Lamarck's work in that of Thierry de Mérouville. I will do this in the winter."

I would not here publish Lichtenstein's original manuscript name did I not think that it would have to be brought into use, owing to the uncertainty about *tomentosus*. In such case we can call the Guanajuato form *C. cacti* subsp. *opuntiæ* (Licht. MS.).

(4) *C. confusus*. Antennæ 7-jointed in well-developed individuals; joint 4 decidedly longer than in Signoret's figure of *cacti*. Smaller than *cacti*, and enveloped in profuse secretion, so that I presume it would be impossible to use it commercially.

This is the form inhabiting the southwestern United States. The most northern locality from which I have seen specimens is Colorado Springs, Colo., November, 1894 (Professor Gillette). Professor Toumey sends it from Tucson, Ariz., on *Opuntia versicolor* Engelm.

Still another form, the *C. bassi* Targ., is quite unknown to me. In Ceylon, also, where the species has been introduced, Mr. E. E. Green recognizes not only the typical form, but a variety which he has named *ceylonicus*.

NOTE.—Mr. Clarence E. Rhodes, one of my students in zoology, has been working out the relative amounts of pigment, weight for weight of the insects as gathered, in the different forms of *Coccus*. Following a method suggested by Professor Goss, chemist of the New Mexico Agricultural Experiment Station, it was ascertained that taking commercial *C. cacti* as 100 the pigment in the same weight of *tomentosus* (*opuntiæ*) from Guanajuato was equivalent to 80, while that of *C. confusus* from Las Cruces was equivalent to only 16. It is evident that *confusus* is of practically no commercial value.

Genus CONCHASPIS Cockerell.

CONCHASPIS Ckll., Bull. Bot. Dept. Jamaica, No. 40, Feb. [publ. March], 1893; Journ. Inst. Jamaica, No. 6, April [publ. May], 1893; Gard. Chron., May 6, 1893. *Pseudinglisia* Newstead, Ent. Mo. Mag., July, 1893, p. 153.

Conchaspis angræci var. **hibisci** n. var.

Female scale.—Differs from *angræci* in being perhaps a little larger, grayish white, with the apex tilted over onto the side; strong ridges, about three in number, run from the apex toward the opposite margin.

Adult female.—Derm colorless, with the last three abdominal segments strongly tinged with brown. Shape elongate-oval. Mouth-parts large; rostral loop either hardly reaching to level of insertion of middle legs, or longer, reaching to insertion of hind legs. Eyes as usual in genus; round gland orifices or spinnerets also normal. Legs short; femur stout, decidedly longer than tibia and tarsus. Claw moderate. Antennæ short, somewhat tapering, brownish, 4-jointed, 2 somewhat longest, the others about equal in length. Abdomen ending in a pair of contiguous lobes, rapidly descending and notched without. Segments with long bristles on their lateral margins, usually a pair on each side but sometimes one, sometimes three. In the thoracic region these bristles are very long, but they become successively smaller on the abdomen.

Habitat.—Tampico, Mexico, on *Hibiscus* sp. prob. *floridanus*. (Townsend No. 28 = Div. Ent. Dept. Agr. No. 6439.)

This occurs on the twigs and leaf stems, whereas the typical *angræci* is found on the leaves of orchids. I place this as a variety of *angræci*, because there is so little in structure to distinguish it, but I presume it is a "physiological species," breeding true and never occurring on orchids.

Dactylopius olivaceus n. sp.

Female (in alcohol).—Long. 3½, lat. 2½, alt. 1½ mm.; dark olive brown, distinctly segmented; on drying becoming whitish from a covering of mealy powder. Posterior tubercles obsolete. Antennæ and legs brown; legs shorter than their distance from one another. Antennæ slender, distinctly narrower than tibia, 8-jointed; 8 extremely long, cylindrical, a little longer than 6 and 7; 1 large, longer than broad; 1, 2, and 3 subequal in length, then 6 and 7 subequal, then 5, then 4 very short; formula 8 (1, 2, 3) (6, 7) 5, 4; joints with sparse whorls of short hairs. Legs very stout, coxa extremely large, the trochanter large. Femur about as long as tibia and tarsus. Tibia about one-third longer than tarsus. Tibia and tarsus apparently with a longitudinal groove, but this appearance is certainly no groove, but seems to be the tendon of the extensor muscle. The usual four digitules present; the tarsal ones quite long, about as long as tarsus. These digitules all filiform, with small round knobs. Derm (by transmitted light after boiling) pale pinkish, transparent, with scattered small round gland spots. Hairs of anogenital ring very small and slender, easily overlooked. Embry-

onic larva pale pinkish; hairs of anogenital ring relatively much larger than in the adult.

Habitat—Ciudad Porfirio Diaz, Coahuila, Mexico, on *Yucca* (prob. *Y. australis*), November 25, 1894. (Townsend; Div. Ent. No. 6464.)

At first I thought I would not describe this species, having only alcoholic material, but its characters are so distinct that it will be easily recognized. It is something like *D. glaucus* Maskell, and is one of those forms which are only placed in *Dactylopius* because no better place can be found for them pending a revision of the dactylopiine genera, for which the time is perhaps hardly ripe.

Eriococcus dubius n. sp.

Female.—When dried, very dark reddish purple (boiled in caustic soda, does not stain liquid); length with sac a little over 3 mm.; sac loosely felted, white, with a slightly yellowish tinge; form as usual in genus. Derm colorless, with numerous stout spines. Legs and antennæ pale brownish yellow. Antennæ fairly slender, 7-jointed, 3 longest, and almost (sometimes quite) as long as 4 and 5, though sometimes 4 is nearly as long as 3; joint 4 longer than 5 and 6; 7 decidedly longer than 5 or 6; 5 longer than 6; formula 3, 4 (1, 2) 7, 5, 6, or 3, 4, 2 (1, 7) 5, 6. Legs moderately slender; coxa longer than tibia, but shorter than femur. Tibia and tarsus subequal; sometimes tibia, sometimes tarsus, a little the longer. Claw very large, not much curved. Digitules ordinary, slender but not filiform. Large bristles on inner side of tibia and tarsus. Hair on trochanter short, not half as long as femur. Posterior tubercles small, but cylindrical, as usual in genus. Anogenital ring with eight hairs.

Embryonic larva elongate, pink, with prominent posterior tubercles emitting the usual long setæ. Rows of spines down the back, as in larva of *Coccus*. Fifteen stout spines on each lateral margin, occupying posterior two-thirds of margin. Legs and mouth-parts large. Antennæ stout, 6-jointed, 3 longest, 4 and 5 shortest, 6 about as long as 4 and 5.

Habitat.—Valles, State of San Luis Potosi, Mexico, on a shrub not identified, but with leaves small, lanceolate, pale apple green above, densely stellate-pubescent beneath. (Townsend, October 13, 1894; Div. Ent. Dept. Agr. No. 6441.)

It is severely attacked by a species of *Leucopis*.

This species proves to be extremely close to *E. coccineus* Ckll., which is no doubt really neotropical, though so far only known from a Nebraska greenhouse. It would have made the differences between *dubius* and *coccineus* clearer if the former could have been described in its living state, but although I had a brief glance at *dubius* before Professor Townsend sent it to Washington it did not occur to me to make any descriptive notes at the time, since I had no idea that I should be the one to introduce the species into the literature. It has been

suggested that this is perhaps not a true *Eriococcus*, but I must agree with Mr. Maskell in placing such forms as this in that genus.

Lecanium imbricatum n. sp.

Female (on twig) about 4 mm. long, oval, moderately convex, much wrinkled, no doubt from contraction in drying, therefore probably soft when alive. Reddish brown, moderately shiny, more or less covered, especially at sides, with a thin, fragile coat of glassy secretion. Derm thickly beset with large brown glands, which, viewed laterally, are broadly fusiform. Anogenital ring with eight long hairs, about as long as the anal plates. Anal plates yellowish brown, longer than broad, with the outer sides nearly equal and meeting at about a right angle. Antennæ very short but thick, rudimentary, joints not distinguishable; tip with several hairs. Legs rudimentary, very short and stout; the femur might almost be described as oval.

Male.—Scale as usual in genus, white, glassy, rugose; very numerous on twig, overlapping one another like tiles on a house or the involucral bracts of a composite plant.

Habitat.—Alta Mira, Tamaulipas, Mexico, on Mimosa, October 15, 1894. (Townsend; Div. Ent. Dept. Agr. No. 6440.)

A very interesting species, of a neotropical type, characterized by a nonreticulate derm with large glands, antennæ and legs often rudimentary or wanting, surface more or less covered with waxy or glassy secretion. The curious South American forms of *Lecanium*, mostly appertaining to this type but very diverse among themselves, have remained practically unknown; at the present time several new species, brought to light by Dr. von Ihering, can only be regarded as a small portion of those which doubtless exist.

The nearest ally of *L. imbricatum* certainly appears to be *L. urichi* Ckll., discovered in Trinidad, but lately received also from Brazil. The Brazilian examples are on *Smilax campestris* Griseb., Rio Grande do Sul (Dr. von Ihering); they seem certainly to belong to *urichi*, but whereas in the types of that species I found no antennæ, on examining a Brazilian example I find short, pale antennæ of about seven joints.

Orthezia sonorensis n. sp.

Female.—Length 2½ mm., with ovisac 11 mm.; breadth of sac 3⅛ mm. Dorsum covered by the white secretion, except a small area posteriorly. Four strong laminæ on each side projecting backward over base of ovisac; median lamina (or pair) very much abbreviated. Derm transparent, thickly beset with small spines. Legs orange brown, coxa broader than long, femur about as long as tibia, tarsus hardly more than half as long as tibia; claw stout, not much curved; claw and distal half of tarsus dark brown. Tibia and tarsus with numerous short stout spines on inner side. [Antennæ broken in the adults examined.] Immature form with 7-jointed antennæ; formula 7, 3 (1, 2, 4) 5, 6; 5 very nearly as long as 4, 7 very slender. Earlier stage with 6-jointed antennæ;

formula 6, 3, 1, 4 (2, 5); 4 sometimes much more slender than 3. Anogenital ring with six distinct hairs. Claw with very small digitules.

Habitat.—San Ignacio, Sonora, Mexico, on "gecota," *Hymenocloa monogyra*. (Townsend, October 4, 1894; Div. Ent. Dept. Agr. No. 6448.)

The affinities of this fine species are clearly with *O. annæ* Ckll., which it much resembles. These forms are of the type of *O. urticæ* Linn. as regards the formation of the laminæ or lamellæ of white secretion.

The following form, closely allied to *P. yuccæ*[1] Coq. (*D. mexicanus* Ckll.), has just been received from Antigua:

Phenacoccus yuccæ, n. var **barberi** Ckll.

Female.—In spirits looks like a *Monophlebus*, the cottony secretion having been lost; whitish, nude, shiny, segmentation distinct; length about 5, breadth about 2½ mm.; legs and antennæ pale reddish brown (very much paler than those of *P. yuccæ*), shiny. Anogenital ring with six stout bristles. Posterior lobes rounded, low, inconspicuous, with a few hairs and numerous short spines, after the manner of *Dactylopius*. Antennæ 9-jointed, the joints subequal, very distinct, bearing whorls of hairs; 9 about one-third longer than 8; 7 a little longer than 8; 2, 4, 5, 6, and 7 practically equal, 2 perhaps slightly the shortest; 3 a little longer than 4; 1 about as long as 2; formula 9, 3 (1, 2, 4, 5, 6, 7) 8. Legs large, ordinary, tibia somewhat longer than femur; tibia and femur each with two rows of stiff bristles, tibial bristles about twelve in a row, femoral about seven. Trochanter with five bristles and one long hair. Tarsus extremely short; excluding claw, it is of the same length as last joint of antenna. Claw large, curved, with a small but very distinct denticle on its inner side. Tarsal digitules filiform, with minute but distinct knobs; digitules of claw filiform. Sides of segments with round patches of small spines.

Habitat.—Collected by Mr. C. A. Barber, in Antigua, on *Allamanda* and *Thunbergia grandiflora*, and also observed by him on *Coleus* and *Croton* growing near the *Thunbergia*. Mr. Barber also sent me numerous specimens which he found on a plant not identified, at St. Kitts.

Although the material sent was abundant, it was all in alcohol and included no males; hence I am unable to determine whether we have to do with a distinct species or not. The distinctions from *yuccæ*, so far as can be made out from the alcoholic material, are very slight, although *barberi* can be easily separated by the pale legs and antennæ. These forms are not typical *Phenacoccus* (*Pseudococcus* Auctt.) by any means, and will doubtless have to be eventually placed in a distinct genus or subgenus. I hesitate to make such a change now, because the whole dactylopiine series stands in need of generic revision, and it will be better to let the matter rest until this work can be taken in hand.

[1] I have received alcoholic specimens of this insect from Mr. Urich, collected in Trinidad. They show joint 3 of antennæ rather longer than 9; otherwise they agree excellently with the *barberi* from Antigua. Mr. Urich writes that he found them in St. Anns, on orange trees, but they were not common.

A LIST OF SCALE INSECTS FOUND UPON PLANTS ENTERING THE PORT OF SAN FRANCISCO.

By ALEXANDER CRAW,

Quarantine Officer and Entomologist, State Board of Horticulture, California.

Name of species.	Country.	Trees and plants.
Aspidiotus albopunctatus *Ckll*	Japan	Orange.
aurantii *Mask.*[1]	Australia	Orange and Fourcroyia.
	Central America	Cocoanut palms.
citrinus *Coq.* MSS.[2]	Japan	Orange, Aucuba, Euonymus.
duplex *Ckll*	do	Camellia, orange, camphor, azalea, Olea fragrans, tea.
ficus *Ashm*	do	Orange, banana, Ilex, Aspidistra.
	Florida	Orange.
	Cuba	Palms (Latania borbonica).
rossii *Mask*	Australia	Palms, olives, Acacia, Araucaria bidwellii.
sphærioides *Ckll*	Louisiana	Ornamental plants.
nerii *Bouché*[2]	Eastern States	Palms.
	Australia	Do.
	Honolulu	Do.
Aulacaspis sp	Japan	Aspidistra lurida.
Asterolecanium pustulans *Ckll*	Honolulu	Oleander.
Ceroplastes ceriferus *Anderson*	Japan	Camellia, orange, gardenias.
floridensis *Comst*	Florida	Orange.
rubens *Mask*	Honolulu	Asplenium fern.
sp	Singapore	Cinnamon.
	Japan	Gardenia fortunii.
Chionaspis aspidistræ *Sign*	do	Aspidistra lurida.
assimilis *Mask*	Australia	Eucalyptus?.
biclavis *Comst*	Tahiti	Orange.
	Southern Mexico	Lime.
citri *Comst*	Australia	Orange.
	Japan	Osmanthus, Aspidistra.
	Samoa	Palms.
difficilis *Ckll*	Japan	
Diaspis amygdali *Tryon*	do	Cherry, peach, plum, apricot, prune, walnut, persimmon, Eleagnus.
patellæformis *Sasak.* (?)	Honolulu	Shrub.
rosæ *Bouché*[2]	Eastern States	Blackberry, rose.
	Central America	Rose.
Dactylopius aurilanatus *Mask*	Australia	Araucaria bidwellii.
adonidum *Linn.*[2]	Eastern States	Croton.
destructor *Comst*	Florida	Orange.
longifilis *Comst*	Eastern States	Dracæna.
pandani *Ckll*	Washington Island, Marq.	
albizziæ *Mask*	Honolulu	Orange.
Eriococcus sp	Australia	Palms.
araucariæ *Mask.*[2]	do	Araucaria excelsa.
Fiorinia camelliæ *Comst.*[2]	Belgium	Camellia.
	Japan	Do.
Icerya purchasi *Mask.*[2]	Australia	Pitisporum.
	Hawaii	Rose.
Ischnaspis filiformis *Doug.*[2]	Japan	Pandanus.
Lecanium filicum *Sign*	New Zealand	Ferns.
hesperidum *Linn.*[2]	Florida	Orange, lemon.
	Honolulu	Orange.
	Australia	Rose.
longulum *Dougl*	Honolulu	Carica papaya.
perforatum *Newst*	do	Palms.
tessellatum *Sign.* (?)	Hawaii	Ferns.
oleæ *Bern.*[1]	Japan	Deciduous magnolia.
	Hawaii	

[1] Established in California for over twenty years.

[2] Found to a limited extent in California, and, with the exception of the two species of *Mytilaspis*, are not feared, as they are mostly held in check by predaceous insects.

Quarantine Officer and Entomologist, State Board of Horticulture, California—Cont'd.

Name of species.	Country.	Trees and plants.
Mytilaspis carinatus *Ckll*	Central America	
citricola *Pack.*[1]	Florida	Orange, lemon.
	Tahiti	Orange.
crawii *Ckll*	Japan	Eleagnus.
gloverii *Pack.*[1]	Florida	Orange.
	Japan	Orange, Magnolia fuscata.
	La Paz	Orange.
Parlatoria pergandei *Comst*	Florida	Do.
proteus *Curtis*	Turkey	Found in San Bernardino County, on imported date palms.
theæ *var.* viridis *Ckll*	Japan	
sp	China	On orange leaves, wood, and fruit.
ziziphi *Lucas*	Italy	Lemons.
Pollinia costæ *Targ.-Toz*	....do	Found on olive in Los Angeles County, and destroyed by Horticultural Commissioner John Scott.
Pulvinaria camelliæ *Sign*	Belgium	Camellia.
	Japan	
psidii *Mask*	Hawaii	Ferns, orange, coffee, pomegranate, alligator pears. A few plum trees in San Bernardino found infested and cleaned out by owner.
Planchonia fimvriata *Fonscol*	Mexico	Climbing plant.
Orthezia sp	Eastern States	Hothouse plants.

[1] Found to a limited extent in California, and, with the exception of the two species of *Mytilaspis*, are not feared, as they are mostly held in check by predaceous insects.

SOME COCCIDÆ FOUND BY MR. ALEX. CRAW IN THE COURSE OF HIS QUARANTINE WORK AT SAN FRANCISCO.

By T. D. A. Cockerell, *Las Cruces, N. Mex.*

Chionaspis difficilis n. sp.

Female scale.—About 2 mm. long, irregular, from round to subelongate, slightly woolly in texture, white, moderately convex; exuviæ to one side, rather inconspicuous, second skin black or nearly so; first skin pale straw color, about one-third on second, but on the side toward the middle of the scales sometimes the exuviæ are reddish. Removed from the twig the scale leaves a very conspicuous snow-white patch.

Male scale.—White, tricarinate, exuviæ almost colorless.

Adult female.—Plump, orange rufous with a slight purple tinge; in caustic soda bluish green, with the pygidial parts dull orange. Five groups of ventral glands, caudolaterals of about 43, cephalolaterals about 41 to 43, median about 37. Median lobes brownish, large, close together at their base, diverging at nearly a right angle; the two sides of the lobe, if produced to a point, would meet at nearly a right angle. These lobes are perfectly entire, or at most very slightly notched on each side. Next each median lobe is a spine-like plate, not so long as the lobe; then the small, low, deeply bifid or bipartite second lobe, adjacent to which is a spine; then two or three spine-like plates, longer than the lobes; then the third lobe, low and bifid like the second, its caudal half larger than the other; then three spine-like plates, resembling the other three; then a rather long interval, on which are three small, low, pyramidal projections, the third with a spine next to it; then four spine-like plates; then a long unbroken or slightly serrate interval; then four or five pairs of large spine-like plates. The anal orifice is a long way from the hind extremity. There are conspicuous rows of oval pores marking the obsolete segments.

Habitat.—Japan, on bark of branches of *Elæagnus*, found by Mr. Craw in his quarantine work, November 13, 1895.

This is one of those puzzling forms which might as well be placed in *Diaspis* as *Chionaspis*. The female presents the closest resemblance to *D. amygdali* Tryon, but the median lobes are practically entire and the glands in the groups appear to be more numerous. The last feature, however, varies in *amygdali*, and doubtless will in *difficilis*. The female scale differs at once from *amygdali* in the color of the exuviæ, and the male scale is quite distinct, being well tricarinate. *Chionaspis major* Ckll. has the tricarinate male scale, but *difficilis* differs from that in its

smaller scale, as well as in its more *amygdali*-like lobes. *Chionaspis prunicola* Mask., which its author scarcely knew whether to put in *Chionaspis* or *Diaspis*, is another similar form. It has not, however, the tricarinate male scale of *difficilis*.

Aspidiotus albopunctatus n. sp.

Male scale.—Very small, hardly over one half mm. broad, circular, becoming at length elongate by the production of one side, and then over 1 mm. long. Slightly convex, dull black, inclining to grayish; exuviæ marked by a white dot surrounded by a black ring. Removed from the bark, the scale leaves a white patch without any dark ring.

Female scale.—Circular, flat, extremely inconspicuous, dull pale ochreous, more or less blackish; on examining the scale from beneath, it is seen that the exuviæ are large and orange. Probably the few female scales seen are not quite adult. Their diameter is about 1 mm.

FIG. 1.—*Aspidiotus albopunctatus* (from drawing by Cockerell).

Adult female.—Pale yellow, of ordinary circular shape; pygidial area striated, no groups of ventral glands. Two pairs of lobes only; median lobes large, close together but not touching, rounded, notched on the outer side and sometimes slightly on the inner; second lobes much smaller, strongly notched on the outer side. Plates spine-like, not very large. Beyond the lobes the margin appears to present three or four irregular serrations, which in well-developed specimens take the form of double spine-like plates. There are two pairs of sac-like incisions, as in *perniciosus*.

Habitat.—Japan, on twigs of orange seedlings, found by Mr. Craw in his quarantine work.

This might easily be considered a form of *A. perniciosus*, which, however, does not seem to affect citrus trees, and is not found on the plums, peaches, etc., from Japan. The characters are almost exactly those of *perniciosus*, but the male scales of the latter have the exuviæ more or less yellowish. The relationship between the two is quite as close as that between *Mytilaspis pomorum* and *citricola*, and I confess that it would not have occurred to me to separate *albopunctatus* as a distinct species but for its habits and locality. It is, in fact, what I have called a "physiological species."

Parlatoria theæ var. **viridis** n. var.

Female scale.—About 1½ mm. long, nearly circular, but the exuviæ projecting at one side give it a broad pyriform outline. From one-third to two-thirds of the first skin overlaps the second. First skin dark greenish to greenish black. Second skin about twice as long as first, nearly round, dark greenish to black, with sometimes a narrow brown

margin. Scale very little convex, white, with a more or less pronounced grayish yellow tinge. Removed from the bark it leaves a white mark.

Adult female.—Very broad, oval, bluish green, with the pygidial area pale orange and the region about the mouth-parts suffused with vandyke brown. Five groups of ventral glands, caudolaterals of 16 to 17, cephalolaterals 9 to 16, median 1 to 4. Lobes pale brown. Three pairs of well-formed lobes, two others rudimentary. Median lobes well produced, squarely incised on each side, the inner notch not so near the end of the lobe as the outer. Second lobes smaller, notched only on the outer side. Third lobes much like the second, but also feebly notched on the inner side near the end. Rudimentary lobes pointed. The scale-like plates, strongly serrated at their ends, are not so long as the median lobes, and not longer than the second and third. There is a pair between the median lobes, a pair between the first and second, and three between the second and third, three also between the third and fourth lobes, and four between the fourth and fifth.

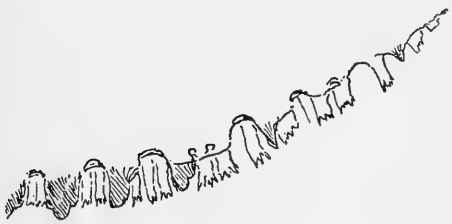


FIG. 2.—*Parlatoria theæ* var. *viridis* (from drawing by Cockerell).

Habitat.—On bark of twigs of an ornamental plant from Japan, found by Mr. Alex. Craw in his quarantine work.

The species of *Parlatoria* are not easy to define, and I really do not know whether in the present case we have to do with a valid species or a variety of *theæ*. At any rate, *viridis* may be known by the more produced tips of the median lobes, the median plates as long as those between the first and second lobes, the bright green color, the five groups of ventral glands, and the pale flattened scale. In *viridis* the lateral groups of glands almost or quite touch one another, while in *theæ* they are well apart. From Maskell's species, *myrtus* and *pittospori*, *viridis* differs at once by the plates being not longer than the lobes. From Del Guercio's *P. targionii* (sub *Aspidiotus*) it differs by the dark exuviæ and other characters. Nor will it agree with the other species, *pergandei*, *proteus*, *zizyphus*, and *victrix*.

Mytilaspis crawii n. sp.

Female scale.—Narrow, about 2⅛ mm. long and one-half mm. wide, slightly curved, pale orange yellow, exuviæ concolorous.

Adult female.—Yellow. Four groups of ventral glands, caudolaterals of 3, cephalolaterals of 4 in a row. Median lobes very large, rounded at ends, their edges finely serrate. They are closely adjacent at a point at the base, being separated, however, by a pair of small spine-like plates; thence they diverge at nearly a right angle to their rounded ends, thence

rapidly sloping, the outward slope longer than the inner, and diverging from it at an angle of about 80°. Next to the outer side of each median lobe is a small spine-like plate, then a sac-like incision, then the small second lobe, shaped much like the last joint of a finger and in bulk hardly one-tenth of a median lobe. Following this is a small sac-like incision, then a pointed projection, then two saccular incisions, then after a short interval a spine-like plate, then another sac-like incision, then a long interval of smooth margin, then another sac, then another interval, in the middle of which is a small spine. Below the sac-like incisions are transversely elongate pores.

Habitat.—Japan. Found by Mr. Craw in the course of his quarantine work, on leaves of an *Elæagnus* from Japan. I do not know the species of *Elæagnus*, but the leaves are about 3 inches long and $1\frac{3}{8}$ inches broad. The scale is extremely inconspicuous, as it lives *beneath the epidermis* on the underside of the leaf along the midrib. By this habit and the large median lobes it will be readily distinguished. From *M. grandilobis* Mask., which has the large median lobes, it is known by the entirely different color of the scale, etc. Several of the specimens were parasitised.

Mytilaspis carinatus n. sp.

Female scale.—$3\frac{1}{4}$ mm. long; second skin about 1 mm., first skin about one-half mm., about one-half on first. Width of scale three-fourths mm. Scale very pale brown, strongly keeled, almost exactly straight, narrow, not shining; exuviæ dull orange. Male scale similar but smaller, with only one pellicle.

Adult male.—Ordinary, well winged.

Adult female (in caustic soda).—Of the ordinary shape, pale yellow. Groups of ventral glands nearly obsolete, but in one example the cephalolateral group, of 4 orifices, is distinct; and the caudolateral, also of 4, is imperfectly developed. There are rows of well-marked elongate pores marking the obsolete segments. Anal orifice a long distance from hind end. Three pairs of lobes, all very small, narrow, and inconspicuous, the median largest, shaped something like a blunt canine tooth, widely separated, with a pair of spine-like plates between. Outside each median lobe is a long spine-like plate, much longer than the lobe, then a short one, then a slight projection; then the third and second lobes, close together but not touching, of about the same size, and

FIG. 3.—*Mytilaspis carinatus* (from drawing by Cockerell).

nearly of the shape of the median lobes; then comes a raised portion, gradually sloping, and exhibiting four or five marginal sacs of no great length; then a notch and two very large spine-like plates, then after a short interval a notch marked by a pair of marginal sacs, then after a rather long interval another notch and pair of sacs, then shortly after another pair of very large spine-like plates, then after a rather long interval a notch and pair of sacs, then after a somewhat longer interval a couple of notches, then a large spine-like plate, then a notch, then a large spine-like plate. The notches might as well be described as serrations.

Habitat.—Found by Mr. Alex. Craw in his quarantine work, October 26, 1895, "upon plants like *Anthurium* arrived from Central America." It occurs on the leaves, in moderate numbers, scattered. It has a certain superficial resemblance to *M. citricola*, but differs at once by the narrower, keeled scale.

SOME NEW SPECIES OF JAPANESE COCCIDÆ, WITH NOTES.

By T. D. A. Cockerell, *Las Cruces, N. Mex.*

I am indebted to Mr. Howard for permission to study some of the interesting Coccidæ found in Japan by Mr. Takahashi when acting as temporary agent of the Entomological Division of the Department of Agriculture. Two of the species described herewith are so anomalous as to form the types of new subgenera; and it is questionable whether they should not rather be placed in new genera altogether.

Genus PULVINARIA.

TAKAHASHIA new subgenus.

Similar to ordinary *Pulvinaria* in general structure, but forming a very long, firm, cottony ovisac, which projects from the twig in a curve about 17 mm. long, carrying on its end the shriveled body of the female.

Mr. Takahashi must forgive me for saying that this is a truly Japanesque insect, and well deserves a subgeneric name which may recall not only its discoverer, but the land from whence come many quaint and beautiful things.

Pulvinaria (Takahashia) japonica n. sp.

Female (in its shriveled condition) about 6 mm. long, reddish brown, blackish on dorsum; carried on the end of a long, curved, white ovisac, about 17 mm. long, firm, cottony, with the fibers running longitudinally. Boiled in caustic potash: derm slightly pinkish, with numerous round gland orifices and apparent short spines, which latter may represent portions of secreted matter protruding. These orifices, etc., not observed at the sides. Rostral loop short. Anal plates dull orange, longer than broad, with their outer angle rounded, and two pairs of strong bristles on inner edge close to posterior end. Anogenital ring with stout hairs, few (I think six) in number. Legs and antennæ very small. Legs ordinary, except that the anterior ones seem to have 2-jointed tarsi. This character is peculiar and will require further study with more material. Trochanter with two hairs, one longer than the other. Femur short, about as long as tibia. Tarsus slender, about two-thirds length of tibia. Claw straight, a little hooked at end; the usual digitules of claw and tarsus present, but all very slender and small. Tarsal digitules extending about as far as tip of claw; digitules of claw

extending a little beyond. Knobs distinct. Antennæ short and stout, 7-jointed; 3 much longest, 4 and 6 equal and shortest; 2 and 5 about equal, also 1 and 7; formula 3 (7, 1) (2, 5) (4, 6); 1, 2, and 4 broader than long; 5 about as long as broad.

Habitat.—Tokio, Japan, on mulberry. (Takahashi; Div. Ent. Dept. Agr. No. 5821.)

Pulvinaria aurantii n. sp.

Female, with white cottony ovisac, scattered over under surface of leaf, looking just like *P. psidii* Mask. The ovisac is about 5 mm. long, irregular or suboval in shape. The shriveled female is ochreous or greenish. Marginal spines numerous, unusually long, quite strong, never branched. Spines of lateral incisions in threes, two small, one large. Rostral loop extremely short. Anal plates together forming about a square. Anogenital ring with numerous hairs. Legs ordinary; tarsus much shorter than tibia; tibia with a very long hair near its end, and a shorter one proximad. Claw short, blunt, curved; digitules of claw very large and stout, with large knobs. Knobs abrupt; stalk comparatively slender, but bulbous at base. Antennæ 8-jointed; 3 longest, but not much so; 2, 4, 5, and 8 subequal; 5 seems a little longer than 4; 6 and 7 equal and shortest; 5 with a very long hair.

Habitat.—Tokio, Japan, on orange. (Takahashi; Div. Ent. Dept. Agr. No. 5941.)

This species looks just like *P. psidii* Mask., and I had almost taken it for granted that it was that species. Microscopic examination, however, at once reveals striking differences, especially in the marginal spines, so that there can be no question about the distinctness of the Japanese form. The following notes on *P. psidii* will serve for comparison and to amplify the published account of that species:

Pulvinaria psidii Maskell.

(1) Material from Maskell, from type locality, Sandwich Islands.

Marginal spines very much smaller and more numerous than in *aurantii*, easily broken off. Those near lateral incisions rather larger than the rest, and broadened and serrate at the ends. Three spines in lateral incisions, one long, two short, as in *aurantii*. Femur and trochanter distinctly longer than corresponding parts of *aurantii*. Tibia with only a short hair near end.

(2) Material from E. E. Green, found in Ceylon.

Shows similar short spines, which *tend to enlarge and branch at ends.* Anal plates together form about a square. Anogenital ring with six long stout hairs. Trochanter with a very long bristle; coxa with two rather short bristles, one shorter than the other. Tibia with a moderately long hair near end. Claw short and curved; digitules of claw practically as in *aurantii*, but knob hardly so abrupt. Antennæ 8-jointed; 3 very much the longest; 4 decidedly longer than 5; 6 and 7

shorter than 5, subequal, narrower in proportion to their breadth than in *aurantii*; 8 about as long as 4; 2 nearly as long as 4.

Pulvinaria tecta Maskell.

A word seems necessary as to this species, since it has been found on orange in Australia. It differs from *P. aurantii* in occurring in masses on the twigs, the females almost smothered in the cotton; in the antennæ, especially in the short second joint; also in the filiform digitules of the claw. These particulars are gathered from Maskell's description; I have not seen *tecta* myself. The marginal spines of *P. tecta*, as figured by Maskell, resemble those of *aurantii*.

Genus SPHÆROCOCCUS.

PSEUDOLECANIUM new subgenus.

Adult female more or less oval, lecanium-like, living exposed on plant or more or less protected by the sheathing bases of leaves; not visibly segmented in adult; antennæ and legs wanting; margin with capitate spines; larva excessively elongated.

Sphærococcus (Pseudolecanium) tokionis n. sp.

Adult female, simply a sac containing larvæ; irregular, more or less oval, about 6 mm. long, dark brown, shiny. Living on twigs and producing a little cottony matter.

I did not succeed in finding legs or antennæ, and believe them to be absent. Margin with capitate spines, shaped like little Agarics. (Spines such as these occur also in *Ceroplastes*.)

As in *Kermes*, which the insect in many ways suggests, the larva affords the best characters. It is very curious that while the adult female is so excessively degenerate, the very young larvæ which pack her body full exhibit more differentiation of parts than is usual in coccid larvæ. The larval antennæ, for example, are like those of an adult coccid, and very different from those usually exhibited by larvæ; so also with the legs. It would seem, in fact, as if ancestral adult characteristics had been pushed back into the earliest larval stage.

Larva pale pink, distinctly segmented, excessively long and narrow, with sides approximately parallel. Skin very finely, longitudinally striated. No hairs on anal ring. Two long caudal bristles, which, bent back, reach about the insection of last pair of legs. No anal lobes; hind extremity notched, with six short blunt spines. A row of stout but short spines along each side, as in a *Kermes* larva. Cephalic end with a row of about ten tubular glands. Legs ordinary; digitules slender, those of claw short, those of tarsus long, extending far beyond those of claw. Tibia longer than tarsus, as is usual in adult (not larval) coccids. Antennæ 6-jointed; the joints very distinct, with strong constrictions between them; joints with short hairs, last one

with an excessively long one; 3 a little longer than 6, and longest; 1 about as long as 6, or a little shorter; 4 and 5 subequal; 2 shortest. Formula 3, 6, 1, 5, 4, 2.

Habitat.—Tokio, Japan, on bamboo. (Takahashi; Div. Ent. Dept. Agr. No. 6308.) Judging from the twigs sent, the bamboo must be one of the smaller ornamental species.

When I saw this, I thought at once of the Sandwich Island *Sphærococcus bambusæ* Mask. I have specimens of this latter, kindly sent me by Mr. Maskell, and it is evidently distinct, though similar in general appearance. The adult female of *bambusæ* is distinctly segmented posteriorly, and so hardly resembles a *Lecanium*, except in the texture of the skin. The larvæ of the two species are also easily distinguished.

The various species which Maskell has described under *Sphærococcus* are strikingly diverse in their characters, and this species may be placed there for the present without widening very much, if at all, the bounds already set by the author of the genus.

Genus LECANIODIASPIS.

Subgenus PROSOPOPHORA Douglas.

Never having seen the type of *Lecaniodiaspis* (*L. sardoa*), I had taken it for granted that Douglas was correct in separating *Prosopophora* as a distinct genus. Recently, finding that *Lecaniodiaspis yuccæ* was undoubtedly a *Prosopophora*, I was led to look more closely into the matter, with the result that I can not separate Douglas's genus satisfactorily from Targioni-Tozzetti's. In leaving *Prosopophora* as a subgenus, I believe I give it the best rank it is entitled to, and even that may be called into dispute.

With the Japanese species described below, the genus contains the following:

(1) *Lecaniodiaspis sardoa* Targ., Mediterranean region.
(2) *L. yuccæ* Towns., New Mexico.
(3) *L. yuccæ* var. *rufescens* (Ckll.), New Mexico and Colorado.

The true *yuccæ* is rounder in outline than *rufescens* and has 7-jointed antennæ, whereas *rufescens* shows distinctly 8 joints. The number of antennal joints is known not to be constant in *L. dendrobii*, and I do not think the difference observed between *yuccæ* and *rufescens* indicates more than a variety. The former was first published and so must stand for the species. It was credited to Riley MS., but the only description which has appeared was written by Professor Townsend.

The var. *rufescens* occurs on chenopodiaceous plants. The Colorado habitat is now first made known; it was sent by Professor Gillette thickly infesting twigs of *Sarcobatus vermiculatus* from Grand Junction, Colo. Some of the specimens in this lot were parasitized.

4. *L. dendrobii* (Dougl.), Demerara.
5. *L. quercus* n. sp., Japan.
6. *L. eucalypti* (Mask.), Australia.
7. *L. acaciæ* (Mask.), Australia.

Lecaniodiaspis (Prosopophora) quercus n. sp.

Adult female.—Scales numerous on twigs. Long. 3½, lat. 2½, alt. 2⅓ mm. Pale ochreous, obscurely carinate, segmentation fairly evident. Boiled in caustic potash, they turn it sherry color. Female (after boiling), dark reddish brown. Antennæ 7-jointed, the joints cylindrical; 1 shortest, much broader than long; then 6 and 7 subequal, much longer than broad; then the other four subequal, but 3 rather longer than 2. Formula (3, 4) (2, 5) (6, 7) 1. Derm with numerous gland orifices and false spines, as usual in genus; derm has a finely marbled appearance, due to minute wrinkles. Margin with a few, short, true spines. Anogenital ring and other characters as usual in the genus. Legs, of course, wanting.

Young larva (squeezed out of the transparent egg-shell) pale pink, rostral filaments curled in two watch-spring-like coils. Antennæ 6-jointed, 2, 3, and 6 subequal and longest. Legs stout, femur about as long as tibia and tarsus. Coxa quite large. Trochanter with two strong curved bristles. Tibia with a long curved bristle on its inner face; tarsus with a small bristle on its inner face. Claw hooked at end; digitules filiform, well developed; tarsal digitules long. Caudal filaments bent back, not nearly reaching insection of last pair of legs. Anogenital ring with distinct hairs.

Habitat.—Tokio, Japan, on *Quercus* sp. (Takahashi; Div. Ent. Dept. Agr. No. 5940.)

This species very much resembles *rufescens*, but is more convex. The occurrence of two species so closely allied, of a peculiar genus, in Japan and New Mexico respectively, is very interesting; similar instances in other groups are known, especially those pointed out by Asa Gray among plants. The conclusion is that we have to do with an old type, which formerly occupied more territory than at present.

Signoret remarked that *L. sardoa* much resembled *Eriococcus buxi* in superficial appearance. *L. quercus* is about the color of the sacs of *Eriococcus eucalypti* Mask., and might easily be taken at a glance for an *Eriococcus*.

Aspidiotus secretus n. sp.

Female scale.—White, shiny; exuviæ exposed, shiny, rather large, very pale yellow, placed rather to one side.

Immature female (boiled in potash) almost colorless, terminal portion brownish; outline nearly round; mouth-parts far posterior, almost as in a *Parlatoria*. No groups of ventral glands. Lobes and spines present, but no plates. Three pairs of lobes; median large, strongly diverging, pyramidal in outline, rounded at ends. On the rapidly descending distal side of each median lobe, at the base, is a small triangular projection. Second lobes separated from this triangular projection by a space about equal to their width. Second lobes smaller than median, but well developed, notched on each side at end so as

to be obscurely trilobed. Two very small projections immediately following second lobe. Third lobe a great distance from the second, small and tooth-like.

Habitat.—Tokio, Japan, on bamboo. (Takahashi; Div. Ent. Dept. Agr. No. 5944.)

Living crowded under the epidermis. The concealed habitat of this species is peculiar; the scales are so closely packed as to be with difficulty separated. In the scale, the insect somewhat resembles such species as *A. nerii*, but the characters of the female are quite different. It is possible that there are delicate and easily deciduous plates, but I found none in the specimens examined by me. The lobes also are peculiar. When I saw the insect under the microscope, I was at once reminded of *A. bossiæ* Mask., but our insect is certainly quite distinct from that, and may not be even closely related.

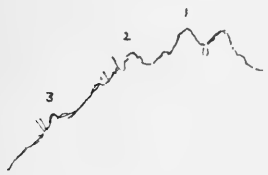


FIG. 4.—*Aspidiotus secretus* (from drawing by Cockerell).

Aspidiotus duplex n. sp.

Female scale.—About $2\frac{2}{3}$ mm. diameter, subcircular, moderately convex, dark blackish brown with the large round exuviæ nearly to one side and orange in color. Removed from the bark, a white patch is left, representing the so-called ventral scale. Female (boiled in potash) pale orange, broadly oval or subcircular, with the large cephalic portion separated from the rest by a deep suture. Mouth-parts large. Skin on dorsum very strongly, transversely grooved, the grooves linear, often anastomosing. Four groups of ventral glands in the usual situation, caudolaterals of 28 to 30, cephalolaterals of 42; median group represented by two orifices, not very close to one another. Besides these groups, there is a group of 17 to 22 orifices, quite similar in character, on each side of the mouth-parts; these groups are oval in outline. The anus is about on a level with the anterior ends of the caudolateral groups. There are four (two on each side) long tubes or ducts originating about the region between the caudolateral groups and the anus, and passing hindward, practically parallel, to the end of the body. On the dorsal surface the segments are marked by rows of oval pores. The "pygidium" shows on the dorsal surface a very distinct latticework, as in *A. theæ* and *Ischnaspis filiformis*. Median lobes very large, brown, rounded at ends, but notched on each side so as to be trilobed; the lateral lobes very small and passing into the straight parallel sides. The median lobes are very close together, but distinctly separated, not touching, not diverging. There are three other pairs of lobes, small, narrow, rounded at ends, very inconspicuous and easily overlooked among the scale-like plates. Plates not extending beyond lobes, scale-like, not separately distinguishable, but forming a continuous fringe

which rapidly narrows beyond fourth lobe, and ceases before the deep notch which indicates another segment. Margin cephalad of fourth lobe distinctly serrate, serrations coarse.

Habitat.—Tokio, Japan. (Takahashi; Div. Ent. Dept. Agr. No. 5643.)

At first sight there appears some resemblance to *Aonidia*, but that genus really represents circular *Fiorinia*. The present insect, *Aspidiotus duplex*, has a sort of double scale, for the brown true scale is covered by a blackish film of secretion, which often extends a little over the exuviæ. I can not see the first skin on the orange exuviæ, but as often happens it is doubtless covered by secretion, and as usual in *Aspidiotus* the orange portion represents both larval skins. If the insect were an *Aonidia*, the blackish film should represent the second skin, and this certainly is not the case.

The almost lateral exuviæ and other characters presented by this species are very peculiar for *Aspidiotus*, but a closely allied form has been described by Mr. Maskell as *Aspidiotus theæ*. This latter infested tea in the Kangra Valley, India, and Assam, and has just the sublateral exuviæ, lattice work pattern of pygidium, and covering film of our insect. It will be distinguished, however, by the scale being light brown (ours is very dark), the film being white (not blackish), and several other minor characters.

In America there is no species very near to *duplex*, but an apparently new species shortly to be described by Mr. W. G. Johnson, found on *Æsculus californica* at Palo Alto, Cal., shows some superficial resemblance and has a similar covering film, though that is whitish. It differs at once from *duplex* in the position of the exuviæ, the obliquely truncate median lobes, the large conspicuous spines, etc. This species of Mr. Johnson's is probably related closely to the European *A. hippocastani* Sign. (which I have never seen), but I think he is correct in considering it distinct.

Genus CHIONASPIS Sign.

Chionaspis latus n. sp.

Female scale.—Similar to that of *Chionaspis aspidistræ*, but broader.

Adult female (cleared in potash and mounted in balsam).—Three-fourths mm. long, about one-third wide; lateral margins of segments somewhat produced, but the breadth of the produced portions greater than the length. Anal orifice rather large, round, level with the interval between the lateral groups of glands. Five groups of ventral glands, median of 8, cephalolaterals 20 to 23, caudolaterals 19 to 22. Length of caudolateral group $\frac{1}{500}$ inch; distance of hindmost gland of caudolateral group from base of median lobes $\frac{1}{490}$ inch; length of median lobes $\frac{1}{225}$ inch. Median lobes brown; the others colorless, or almost so. Median lobes obliquely ascending to the median line, at which they are contiguous for their whole length, the two lobes together forming nearly the outline of a half circle. The descending external margins are thrice

deeply notched, thus becoming conspicuously crenate. Each lobe is deeply incised at its base, but except for this it would form a nearly right-angled triangle, the right angle being the inner basal one. The length of each lobe in the median line is about as great as its breadth at the base, or somewhat greater. Immediately outside each lobe is a spine, then comes a large plate, conical in outline; then a pair of lobes resembling in shape human incisor teeth, but more narrowed basally; then a long spine; then a pair of oblong plates, followed by what may be a very rudimentary lobe, marked at the base like the previous pair of lobes by a round, low prominence bearing a short hair; then after a short interval comes a low, broad serration on the margin, followed by a number of minute serrations, toward the end of which is another short hair springing from a round spot; after this comes a short interval and then a very long spine-like plate; then a prominence bearing a gland; then after an interval two very long, spine-like plates. The saccular glands along the margin, as in other species, are about twice as long as broad. Close to and parallel with the margin are seven transversely elongate pores, rod-like in form.

Habitat.—Tokio, Japan, on orange. (Takahaski; Div. Ent. Dept. Agr. No. 6490.)

Allied to *C. braziliensis* Sign., *C. theæ* Mask., and *C. minor* Mask., but scale much broader. *C. minor*, which it much resembles structurally, has a white scale. *C. latus* is quite distinct, structurally, from *C. citri*.

Chionaspis bambusæ n. sp.

Female scale.—About 2½ mm. long, pyriform in outline; snow-white, with the exuviæ pale straw color; second skin often tipped with orange. In all respects this scale so closely resembles *C. vaccinii* Bouché as to be practically indistinguishable. From the Ceylon *C. graminis* Green MSS. found on *Andropogon*, it is at once distinguished by the shorter second skin.

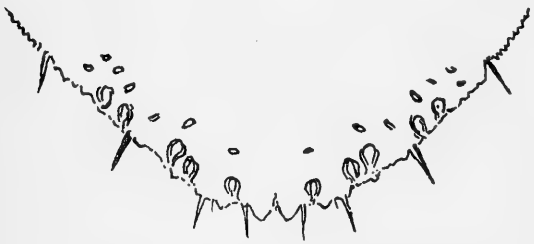


FIG. 5.—*Chionaspis bambusæ* (from drawing by Cockerell).

Adult female resembles *C. vaccinii* a good deal, but the four (two pairs) lobes are smaller, and the median ones narrower and not touching at their bases as in *vaccinii*. The ventral grouped glands are in five groups, as usual, but the orifices are much less numerous than in *vaccinii*. The oval (dorsal) pores are very large and distinct; adjacent to the lobes they form "incisions with thickened edges," as in some species of *Aspidiotus*. The spine-like plates are large; the margin cephalad of the fourth of these plates is serrate.

Habitat.—Tokio, Japan, on leaves of bamboo, July, 1894. (Takahashi; Div. Ent. Dept. Agr. No. 6609.)

The *C. vaccinii* used for comparison are on *Vaccinium myrtillus*, from Králové Dvûr, Bohemia (*Karl Sûlc*).

Parlatoria theæ n. sp.

Female scale.—On bark of twig, very inconspicuous, about $1\frac{2}{3}$ mm. long, oval in outline, slightly convex, pale ochreous, with the second skin black or nearly so. Second skin not far from circular, rather less than one-third total length of scale; first skin about half overlapping second. Removed from the twig, the scales leave a white mark, representing the so-called ventral scale.

Adult Female.—(Boiled in potash) colorless, with the lobes pale ochreous. Mouth-parts as usual in genus. Grouped glands present, caudolaterals of about 7 orifices, cephalolaterals of about 20, median

Fig. 6.—*Parlatoria theæ* (from drawing by Cockerell).

group represented by a single orifice only. Lobes of the type of *P. pergandei*. I find it almost impossible to adequately describe in words the abdominal fringe of this or any other species of *Parlatoria*, and so give a figure which will facilitate identification.

Habitat.—Japan, precise locality not stated; on tea plant. (Takahashi.)

The dark second skin, which is comparatively small, distinguishes this species; at a glance it looks not unlike *Aspidiotus camelliæ*. It is attacked by a fungus, of which, however, I have seen only the mycelium.

Phenacoccus pergandei n. sp.

Female with ovisac $8\frac{1}{2}$ mm. long, 3 broad. Ovisac white, firm, not grooved, partly overlapping the wrinkled, orange brown female.

Female (boiled in potash) turns the liquid a pale, port-wine color. Derm colorless, with numerous gland spots and some small spines. Antennæ and legs pale ochreous, comparatively large. Antennæ distinctly 9-jointed; 3 longest, 2 nearly as long and decidedly stouter; 1, 4, 5, 6, and 9 subequal; 7 and 8 subequal and shortest; formula 3, 2 (1, 4, 5, 6, 9) (7, 8); 1 with two stout hairs near its end, 2 with a long hair, 3 with a pair of hairs near the end; remaining joints each with a whorl of hairs; last joint with also apical hairs representing a second whorl. Legs ordinary; coxa very large, with a whorl of bristles near its end; trochanter and femur with scattered bristles; femur with an erect hair on its inner face, just before its middle. Tarsus less than half as long as tibia; tibia with about five bristles on its inner face and six on outer. Tarsus with bristles. Claw long, not much curved; digitules of claw of fair size, expanding rather gradually to their bulbous ends. Tarsal digitules wanting.

Habitat.—Japan, precise locality unknown, on "Gumi." (Takahashi; Dept. Agr. No. 5942.) The scales occur on the undersides of the leaves, along the midrib. What "Gumi" is, I do not know, but it has entire rather hairy leaves about 40 mm. long, suggestive of some solanaceous or scrophulariaceous plant.

At first sight the species looks like a very much developed *Pulvinaria camellicola*, but the texture of the ovisac suggests *Lichtensia*. I had actually described it as a new *Lichtensia* and had sent the MS. to Washington, when Mr. Pergande, having occasion to examine the insect, discovered the extraordinary error into which I had fallen. The specimens were much attacked by parasites (a species of *Comys*, I learn from Mr. Howard), and the legs, antennæ, etc., were detached. Thus, having gotten the erroneous idea that the thing was a lecaniid, I described from what I could see, notwithstanding the absence of the anogenital parts, etc. On receiving Mr. Pergande's statement, I boiled down a new specimen, and was fortunate enough to see the anal ring, perfectly normal for *Phenacoccus*, to which the insect unquestionably belongs. I mention these incidents because such errors are always interesting, throwing light on the probability of error in scientific writings. I have sometimes seen it stated that so-and-so could not have made a certain mistake, because he knew better; but a careful analysis of mistakes will show that a large percentage would not have been made if the writer had known less. For example, a traveler in a foreign country will often announce that he saw some bird or insect very familiar to him at home, and when it is denied that the species occurs there he will indignantly ask whether we suppose he does not know the common so-and-so. As a matter of fact, he has been misled by a superficial resemblance; whereas had the object been quite unfamiliar to him he would have taken pains to arrive at its correct identification, probably with success.

Technical Series No. 3.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

A STUDY

IN

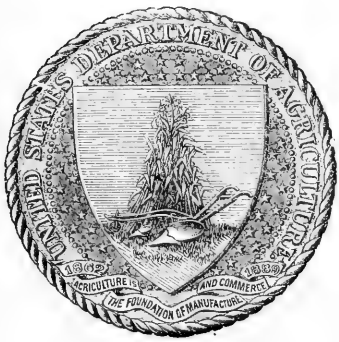
INSECT PARASITISM:

A CONSIDERATION OF THE PARASITES OF THE WHITE-MARKED TUSSOCK MOTH, WITH AN ACCOUNT OF THEIR HABITS AND INTERRELATIONS, AND WITH DESCRIPTIONS OF NEW SPECIES.

BY

L. O. HOWARD,

ENTOMOLOGIST.



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Assistants: R. S. Clifton, Nathan Banks, F. C. Pratt.

Artist: Miss L. Sullivan.

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., February 1, 1897.

SIR: I have the honor to submit for publication, under the title "A Study in Insect Parasitism," an account of the principal factors which brought about the almost total disappearance of tussock-moth caterpillars on the shade trees in the city of Washington during the summer of 1896, after an extremely injurious outbreak of this insect which took place during the summer of 1895. The details of this study may be considered in a degree typical of many sudden interruptions of the rapid multiplication of injurious species of insects. On account of the fact that the detailed consideration of the problem involves the close record of many details of little popular interest, as well as the description of a certain number of new species, it seems best that the paper should be published in the Technical Series of bulletins of this division.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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A STUDY IN INSECT PARASITISM.

By L. O. Howard.

INTRODUCTION.

The white marked tussock moth (*Orgyia leucostigma* Smith & Abbott) is an insect which prior to the early seventies was known mainly from the occasional defoliation of the leaves of orchard trees by its larvæ. Harris referred to it as an enemy of apple trees and rose bushes and sometimes of "other trees and shrubs." Fitch mentioned it as an enemy of apple trees and rose bushes; while Riley, in his First Missouri Report (1869), referred to it as an apple insect, but stated that it feeds upon different kinds of trees, such as elm, maple, horse-chestnut, and oak, seeming, however, to prefer the apple, plum, rose, and pear.

Since a somewhat indefinite date, which we can fix no closer than the early seventies, this insect has become more or less prominent as an enemy to shade trees in the cities of the northeastern United States, and correspondingly has become less prominent as an enemy to orchards. The beginning of its rapid increase in our cities is nearly coincident with the beginning of the remarkable multiplication of the English sparrows after their introduction into this country, and there seems little doubt that this coincidence is really a matter of cause and effect. One of the early results of the introduction of the English sparrow was the practical extermination by this bird of the canker-worms, which at that time were the principal insect enemies of our city shade trees. The removal of the canker-worms afforded room for the multiplication of the tussock moth, which, from the fact that its larva is hairy, was not eaten by the sparrows, and consequently multiplied with rapidity.[1] Furthermore, the tussock moth must be considered as one of those species which are becoming attached to cities—which are slowly altering their habits and accommodating themselves to city environment.

For many years the shade trees in more northern cities, and notably in Boston, New York, Brooklyn, and Philadelphia, have suffered severely from the attacks of this hairy caterpillar. Until recently, however, the species has not been excessively abundant in the city of

[1] This supplanting of the one species by the other was also undoubtedly due in part to the driving away by the sparrows of the native birds which previously had fed upon the tussock-moth caterpillars. Le Conte has shown (Proc. Am. Assoc. Adv. Sci., vol. 23, p. 44, 1874) that the larva of *Ennomos subsignaria*, a measuring worm which had been very injurious to the shade trees of Philadelphia, was replaced by the tussock-moth caterpillars through the sparrows eating the former and avoiding the latter.

Washington. Its place in that city seems to have been taken largely by the fall webworm (larva of *Hyphantria cunea* Drury) and the bagworm (larva of *Thyridopteryx ephemeraformis* Haworth). The tussock-moth larvæ, however, have been moderately common year after year, but not until 1895 did they increase so as to attract general attention. In 1895, however, Washington suffered from an extraordinary outbreak of this insect, as the writer has already pointed out in his article on "The shade-tree insect problem in the eastern United States," published in the Yearbook of the Department of Agriculture for 1895, pages 361–384. In this season the trees along many streets were completely defoliated, and in the autumn they were plastered in the most unsightly way with their cocoons.

In August, 1895, the writer commenced a careful investigation of the life history of the insect with the feeling that, although much had already been written upon the species, there was still more to be learned about it. As a matter of fact, new and important points in the life history have been determined in the course of this study, but none of them are of so much interest as the facts relating to the extraordinary phenomena of parasitism, induced by the unprecented multiplication of the species.

Many observations are recorded which show the prominent part which parasites take in the reduction of an insect which under favorable conditions has exceeded its normal bounds in respect to numbers. Such constant struggles between species in the apparent effort to preserve a just balance are met with by every observer in the course of nearly every season's observations. The writer has, however, always desired an opportunity to study the exact details of such a struggle upon a large scale, and this opportunity was afforded in this instance.

In Boston, New York, Brooklyn, and Philadelphia the tussock moth has not seemed to fluctuate seriously in point of numbers. It has been more or less injurious every season for a number of years. In Washington, however, in 1895, there was a rapid and enormous increase, and great fears of its continuance year after year were expressed by city authorities, by the newspapers, and by citizens interested in the beautiful shade trees of the city. By the time the third generation had made its appearance in September, 1895,[1] it was noticed that parasitic and predaceous insects were present in enormous numbers. The cocoons of the second generation were the rallying point of hordes of Ichneumon and Chalcis flies, while several species of predatory Heteroptera were present in great numbers. The trunks of nearly all of the large trees in the Government parks were sanguinary battlefields where the resulting mortality was excessive.

Prior to the beginning of these observations seven species of probable primary parasites of the tussock moth had been recorded. Fitch

[1] Observations of 1896 have shown without doubt that there are three annual generations in Washington instead of two, as previously stated. (See Bulletin No. 10, Division of Entomology, p. 33.)

had described two as *Trichogramma orgyiæ* and *T. fraterna*. The first of these, however, seems to be a Cratotechus which has not since been reared, while the second is a hyperparasite of the genus Holcopelte. There is not the slightest evidence, however, that this second parasite ever attacks the tussock moth, since Fitch simply found it walking upon rose leaves in September, "where," he says, "it was very probably searching for these same caterpillars in which to deposit its eggs." Riley reared *Pimpla inquisitor*, an undetermined Tachinid fly, a true egg parasite of the genus Telenomus, and two species of the genus Pteromalus, while he also obtained cocoons of a Microgaster from tussock-moth caterpillars, without, however, rearing the adult. The adult of what is probably this species was reared later by Prof. F. M. Webster and was described by Mr. Ashmead as *Apanteles orgyiæ* (Bull. Ohio Exp. Sta., Tech. Ser. I, p. 159). Dr. Weed records (Psyche, V, 51) *Pimpla conquisitor* Say, Normal, Ill., July 14, 1883. Dr. Lintner is also said to have reared a species of Tetrastichus from this larva. This last species is undoubtedly hyperparasitic, and one if not both of the two species recorded as belonging to the genus Pteromalus are also probably hyperparasites.

The close observations which were made upon abundant material beginning early in August, 1895, and carried through until the autumn of 1896, have resulted not only in vastly increasing this list, but in giving us some definite ideas as to the habits of the species involved and as to their more or less intricate interrelations.

The species reared are as follows:

LIST OF PRIMARY PARASITES.

A.—*Hymenoptera.*

Pimpla inquisitor Say.
Pimpla conquisitor Say.
Pimpla annulipes Say.
Amorphota orgyiæ n. sp.
Meteorus communis Cresson.
Meteorus hyphantriæ Riley.
Limneria sp.
Limneria valida Cresson.
Theronia fulvescens Brullé.
Apanteles delicatus n. sp.
Apanteles hyphantriæ Riley.
Chalcis ovata Say.
Pteromalus cuproideus n. sp.
Cratotechus orgyiæ Fitch.
Telenomus orgyiæ Fitch.

B.—*Diptera.*

Frontina aletiæ Riley.
Frontina frenchii Will.
Tachina mella Walk.
Euphorocera claripennis Macq.
Exorista griseomicans V. d. W.
Winthemia 4-pustulata Fab.

LIST OF HYPERPARASITES.

Hymenoptera.

Hemiteles townsendi Ashmead.
Bathythrix meteori n. sp.
Bathythrix pimplæ n. sp.
Adistola americana n. sp.
Otacustes periliti Ashm.
Habrocytus thyridopterigis Ashm.
Pezomachus insolitus n. sp.
Spilochalcis debilis (Say).
Eupelmus limneriæ n. sp.
Dibrachys boucheanus (Ratz.).
Elachistus cacœciæ How.
Elasmus atratus n. sp.
Syntomosphyrum esurus (Riley).
Asecodes albitarsis Ashm.

LIST OF PROBABLE PARASITES.[1]

Ichneumon subcyaneus Cresson. Ichneumon cœruleus Cresson.
Allocota (Hemiteles) thyridopterigis Riley.

LIST OF SCAVENGERS.

(Reared from dead chrysalids or cocoon masses.)

Diptera.

Helicobia helicis Towns.
Sarcophaga spp. 2.
Phora nigriceps Loew.
Phora incisuralis Loew.
Phora fasciata Fall.
Phora agaraci Lintner.
Limosina sp.
Homalomyia scalaris Fab.
Gaurax anchora Loew.
Neoglaphyroptera bivittata Say.
Diplosis sp.

In addition to the insects listed above, a species of Chrysopa was reared from the cocoon mass, the larvæ of *Anthrenus varius* were found feeding upon the dead pupæ and empty egg masses, and a mite of the genus Tyroglyphus was found to have the same habit.

Other active agents in the further reduction of the numbers of the tussock-moth caterpillars were an undetermined disease upon which Mr. A. F. Woods, of the Division of Vegetable Pathology, has been at work, and the Heteroptera *Podisus spinosus*, *Euschistus servus*, and *Prionidus cristatus*.

The total number of primary parasites reared in the course of the observations was 2,122, of which 185 were Diptera and 1,937 Hymenoptera. The secondary parasites numbered about 1,000, but this is an estimate, as no exact account was kept of the many specimens of the minute Dibrachys and Asecodes. The writer deems it advisable to give in some detail the observations made upon each of these species in order before drawing general conclusions, since the basis for such conclusions must be the knowledge of the habits of the individual species involved.[2]

Pimpla inquisitor Say.

This important and widespread parasite of lepidopterous larvæ occurs in California, Texas, Iowa, Illinois, Missouri, Ohio, New York, and the District of Columbia, and is probably to be found in all parts of the United States, except possibly in boreal regions. It is parasitic

[1]All observed closely investigating recently formed cocoons of the tussock moth and apparently about to oviposit. The third species is parasitic upon Pimpla.

[2]The observations upon which the following statements are based have largely been made by Mr. Pergande, the assistant in charge of the insectary. Messrs. Pratt and Busck have also helped, and Mr. Coquillett was for a short time in charge of the breeding experiments during Mr. Pergande's absence. The writer made certain field observations in the fall of 1895 and summer of 1896, and carefully dissected and examined very many Orgyia cocoons during December, 1896. The dipterous parasites have been named by Mr. Coquillett, and Mr. Ashmead has assisted in the naming of the Hymenoptera.

upon a large number of lepidopterous larvæ, feeding upon such Bombycids as Clisiocampa and Orgyia, upon certain Phycitids, Tortricids, and large-sized Tineids. It was by far the most abundant of the parasites reared, no less than 1,659 having issued in the course of our observations upon the parasites of *Orgyia leucostigma*.

Observations were first begun on August 31, 1895, at which time five eggs were noticed upon a larva which had spun its cocoon and had died without transforming to pupa. Two similar eggs were found upon another caterpillar under like conditions. A few days later many more were found. They were generally attached to the dorsal portion of the abdominal segments of the caterpillar and usually at the juncture of two segments and always set up on end, attached by the small end. They were not firmly attached and were occasionally rubbed off by the contortions of the larva, being retained, however, by the silken threads of the cocoon.

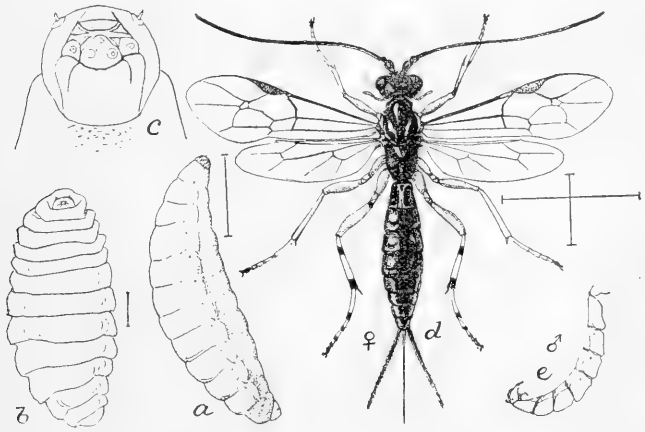

FIG. 1.—*Pimpla inquisitor*: *a*, full-grown summer larva; *b*, hibernating larva; *c*, mouth-parts of larva; *d*, adult female; *e*, abdomen of adult male from side—all enlarged, *c* greatly enlarged (original).

These eggs are much elongated, somewhat wider at one end than at the other, pure white in color, and perfectly smooth, appearing highly polished. The average length is 0.98 mm. and the greatest width 0.18 mm. The duration of the egg state must be very short and probably a matter of but a few hours. After hatching, the larvæ were found to feed externally upon the body of the caterpillar, the mouth parts closely applied to the skin, and, in fact, obviously sucking blood through a minute orifice. Their growth was rapid and there was no perceptible exuviation. The seven eggs found on August 31 had hatched the following day and by September 3 the larvæ appeared to be nearly full grown. When full grown, the largest larvæ are 9.5 mm. in length by 3.2 mm. in greatest diameter, fusiform in shape, and slightly curved in normal position. The color is yellowish white, some specimens taking on a pinkish tinge, and there are no markings. The

spiracles are very minute. There is no anal opening, but its position is indicated by a short curved transverse impression just ventrocephalad of the anal extremity. The mouth parts are so well shown at fig. 1*c* as to need no description. The form and general appearance of the full-grown larva are also shown at fig. 1*a*.

On September 6 these larvæ were found to be spinning their cocoons. These cocoons, at first white and afterwards turning gradually to a pale yellow-brown, becoming much the same color as the cocoon of the Orgyia, are denser in structure and composed of a considerably finer quality of silk. They are long oval in shape, the longest reaching a length of 16 mm. by 4 mm. in diameter. The cocoons spun by the larvæ issuing from a single caterpillar are closely applied together and adhere so firmly that it takes some little force to separate them. They

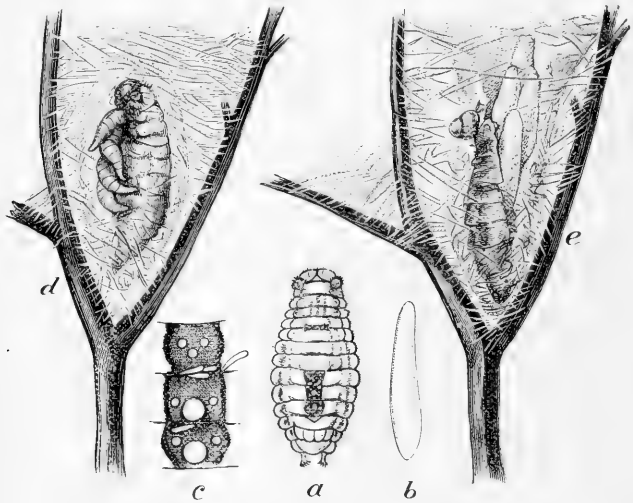

FIG. 2.—*Pimpla inquisitor*: *a*, shrunken tussock moth caterpillar bearing parasite eggs *in situ*; *b*, egg; *c*, eggs *in situ*; *d*, larvæ, full grown, feeding on spun-up caterpillar; *e*, cocoons of parasite within Orgyia cocoon—*a*, *d*, *e* slightly enlarged, *c* still more enlarged, *b* greatly enlarged (author's illustration, from Yearbook, Dept. Agric., 1895).

are applied side by side and so closely that their oval outline becomes more or less angular at the points of application. The fastening together is not exactly regular, since one or more cocoons will frequently extend farther out than the others. Twenty-four hours after the spinning of the cocoon the larvæ were still found unchanged, but at forty-eight hours, or on September 8, they changed to pupæ.

All of the adults issued together on September 14, leaving fifteen days as the duration of the life round, as follows: Egg, one day; larva before spinning cocoon, seven days; larva after spinning cocoon, one day; pupa, six days—total, fifteen days.

This rapidity of development is somewhat surprising. The writer has recorded a much greater rapidity with certain Chalcidids, but is not familiar with any record of a similarly rapid development with an

Ichneumonid. Ratzeburg (Die Ichneumonen der Forstinsecten, p. 14, Band 1) states that the shortest life round of any of the parasitic Hymenoptera known to him is that of *Pimpla fulvipes*, from July 15 or 16 to August 5—twenty or twenty-one days. In this instance the host was *Lithosia quadra*, a spun-up larva of which was found July 16 bearing eight small white Ichneumonid eggs. On the 17th the eggs had hatched; on the 19th the larvæ had become quite large; on the 20th they had begun to spin; on the 23d they had inclosed themselves in small white cocoons; on the 25th they had transformed to pupæ; on August 3 the colors of the adult were noticeable, and on the 5th the first adult issued.

Adult females of *Pimpla inquisitor* were watched many times when searching for caterpillars of the proper condition for oviposition. On September 10 five individuals were observed to oviposit in tussock-moth caterpillars. The first one stung a larva which was just spinning up. The Pimpla ran up to the posterior end of the cocoon, stood for a moment with antennæ vibrating on the cocoon as though to ascertain the exact condition of affairs, then suddenly ran a short distance forward, bringing its ovipositor into a somewhat forward-directed position, and quickly inserted it through the silk and into the body of the caterpillar, which at once commenced to struggle violently. The wasp was not disturbed and remained in position for some minutes. The caterpillar was then examined and it was found that a Tachinid egg had already been deposited upon it between the second and third thoracic segments. It was placed aside to endeavor to rear the parasite, but the attempt was not successful and nothing was bred from it. A second and third one were observed to act in the same manner, the operation in each case lasting about two minutes. No adult parasites were bred in either case. A fourth oviposited in a webbed-up caterpillar, which, when stung, already carried some eggs of the same species. A fifth, after running about for fifteen minutes examining a cocoon here and there, was seen to enter the opening at the anterior end of one of the cocoons and remained inside of it for several minutes. The cocoon was removed and examined and it was found that the caterpillar was dead and with it was one half-grown larva of this parasite, the offspring of some previous visitor. No adults were reared as the result of any one of these five observations. It was noticed on the following day that two and even three females of the Pimpla would occasionally engage at the same time in ovipositing in the same cocoon. In the

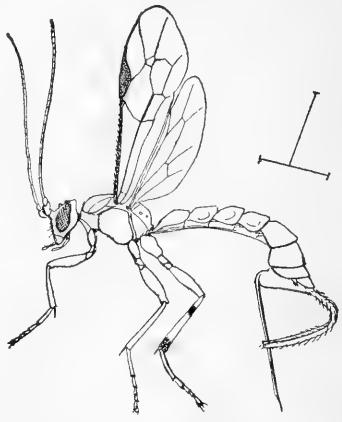

FIG. 3.—*Pimpla inquisitor*: Adult female, from side—enlarged (original).

majority of the cocoons examined the caterpillars were contracted, but had not pupated. In one case, however, one had transformed to pupa, and near its posterior end were found a number of recently deposited eggs of the Pimpla.

Further observations upon oviposition were made on September 13. On one cocoon containing a recently spun-up larva two of the parasites were seen ovipositing at the same time. One of them, after running about for a few seconds, suddenly thrust its ovipositor into the body of the larva, which commenced to wriggle in pain, but the parasite was undisturbed and pushed its ovipositor in to its full extent, remaining motionless in this position for about five minutes, during which time the abdomen slightly moved in a peristaltic manner as if forcing the eggs out and down through the ovipositor. It then withdrew the ovipositor, turned around, took a step or two, and gave the caterpillar three thrusts in quick succession. It then went a little farther and gave several more thrusts, and continued the same operation four times more, when it again thrust its ovipositor in as far as the body, remaining in this position again for several minutes. When the cocoon was examined, four eggs were found loose inside the cocoon. Here again, however, nothing was reared. Another one was observed ovipositing in a recently spun-up larva. It was seen to thrust the ovipositor in three times, lasting one minute, one and one-half minutes, and one-half minute. It was also noticed to thrust the ovipositor in at another place in the cocoon five or six times in quick succession, as if in search of the larva. When the cocoon was examined four eggs were found, all in a bunch between the first and second segments, and in an upright position, but so loosely attached that they became detached after the cocoon had been slightly handled. It seems as though the preliminary stinging of the caterpillar were done to quiet it so that the eggs when laid would not be detached by its struggles. A parasite placed in a tube with a larva which had been stung was later found to have deposited five eggs, which were adhering to the glass and not to the larva.

An observation was made September 14, which indicated that all of the larvæ do not feed externally, since from a discolored caterpillar collected September 4 and placed in a tube a larva of this Pimpla issued on September 14, and spun a cocoon, the adult issuing September 20.

It sometimes happens that a larva is stung when just on the point of transforming, and in such a case the transformation to pupa is occasionally accomplished. The recently formed pupa is also occasionally stung, as has just been shown. Contrary to the general rule holding when caterpillars are eaten out by the Pimpla larvæ, they seem to feed within such pupæ, and eventually to spin their cocoons within the Orgyia pupa skin. Several times in December, 1896, apparently perfect female pupæ of the Orgyia were found within their cocoons, with a closely applied layer of four or five Pimpla cocoons and a single break in the

pupa skin from which the end of another Pimpla cocoon slightly extruded. In all such cases the removal of the perfect pupa skin showed its contents to be a very closely packed mass of Pimpla cocoons. In one case of this kind the pupa skin was found to contain six large female cocoons of the Pimpla and one larva which had died while engaged in spinning and had only succeeded in spinning a thin web, while attached to the outside of the pupa skin were four large perfect Pimpla cocoons.

With this species, as with so many other parasitic Hymenoptera, and indeed as with so many other insects in general, there was a marked priority in the issuing of the males. The proportions of the sexes were carefully noted among those issuing in March, 1896, with the following rather striking results:

March 3	2 ♂	
4	1 ♂	
5	2 ♂	
7	6 ♂	
9	11 ♂	
10	9 ♂	
11	18 ♂	
13	7 ♂	1 ♀
14	8 ♂	1 ♀
16	7 ♂	
March 17	11 ♂	8 ♀
18	10 ♂	3 ♀
19	9 ♂	14 ♀
20	1 ♂	20 ♀
21	1 ♂	5 ♀
23	2 ♂	9 ♀
24	1 ♂	1 ♀
26	8 ♂	6 ♀
27	1 ♂	1 ♀

The pair issuing March 27 were placed in the same vial and watched. They at once copulated and repeated the act seventeen times during the first ten minutes and six times during the next ten minutes. They then rested for a time. During the next hour, however, they copulated five times and during the succeeding two hours six times. On March 28 both were still alive, but on the 30th both were dead.

It is worthy of remark that these spring individuals from overwintering cocoons are smaller in size than those which issued the previous September.

It happened on several occasions that the adult Pimpla was observed to oviposit in tussock-moth caterpillars which were already infested with Tachinid larvæ. Several such caterpillars were isolated for observation, and in every case but one there was no development to maturity of either the dipterous or the hymenopterous parasite. In one case, however, an adult of the Tachinid *Euphorocera claripennis* issued from such a caterpillar. The probabilities are that its larva was already well grown when its host was stung by the Pimpla and that the larvæ of the latter failed to find sufficient nourishment for development.

Such instances would seem to show that the maternal instinct is not so prescient as has been supposed, and that all the preliminary investigation of the host insect by the mother parasite and all the apparently anxious soundings and tappings with her antennæ, while appearing to satisfy her that everything is all right, do not always result in the depositing of the eggs under just the proper conditions. It is altogether likely that other parasitic Hymenoptera occasionally, and perhaps frequently, make similar mistakes, and that many parasites suffer

from this rivalry based upon erroneous instinct, as well as from the attacks of hyperparasites. Such mistakes are of course much more likely to occur during such times of extraordinary multiplication than when the species are normally abundant.

During the entire series of observations careful records were kept of all specimens of Pimpla reared. The following table indicates numbers and dates:

Date.	Number.	Date.	Number.	Date.	Number.	Date.	Number.
1895.		1895.		1896.		1896.	
Sept. 12	5	Oct. 9	6	Mar. 19	23	July 9	2
13	15	11	5	20	21	10	23
14	12	12	7	21	6	11	22
16	6	15	2	23	11	13	224
17	9	Nov. 6	2	24	2	14	50
18	12	9	3	26	14	15	82
19	22	14	2	27	2	16	100
20	55	19	1	30	7	17	60
21	96	Dec. 6	1	31	5	18	60
23	90	1896.		Apr. 1	1	20	100
24	76	Jan. 9	1	2	3	21	50
25	25	Mar. 3	2	3	2	22	50
26	20	4	1	6	3	23	20
27	7	5	2	7	1	24	12
28	4	7	6	9	1	25	10
30	5	9	11	10	5	27	3
Oct. 1	1	10	9	11	1	28	4
2	4	11	18	13	4	31	1
3	3	13	8	14	8	Aug. 4	1
4	12	14	9	16	1	10	2
5	7	16	7	18	5	26	1
7	5	17	19	20	19		
8	8	18	14	21	2	Total	1,659

It will be observed that the periods of greatest abundance were from September 12 to 26, 1895; from March 9 to 26, 1896; from April 10 to 20, 1896, and from July 10 to 25, 1896.

The percentage of parasitism by this species was indicated rather plainly by four series of experiments. From 100 cocoons collected September 10, 1895, there issued 38 adults; from about 500 cocoons collected August 23, there issued 300 specimens; from about 300 cocoons collected August 21, there issued 172; from 604 cocoons collected between June 30 and July 8, 1896, there issued 729.

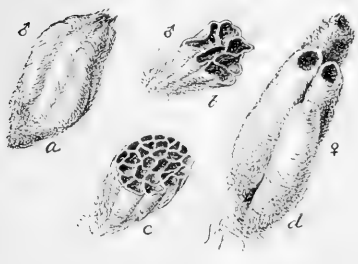

FIG. 4.—*Pimpla inquisitor*: *a*, mass of male cocoons; *b*, do., cross-sectioned; *c*, cross section of largest cocoon mass found; *d*, mass of female cocoons—nat. size (original).

We have not previously stated definitely the number of specimens of the parasites nourished by a single Orgyia. The number in summer varies from 1 to 10, with perhaps an average of 3 or 4. This number refers to the large well nourished larvæ, mainly females. In the late autumn more are found. Ten to fifteen Pimpla cocoons in a single Orgyia cocoon are not at all unusual at this time of the year, while from a single Orgyia cocoon collected by Mr. Busck in September, 1896, were reared no less than 23 Pimplas, all of which were males. This particular Pimpla cocoon mass was cross-sectioned, and is illustrated at fig. 4c.

The total number of specimens of the Pimpla reared appears to us to be very extraordinary, and in itself almost accounts for the nearly total annihilation of the first 1896 brood of tussock-moth caterpillars.

The specimens of the Pimpla issuing in March and April, 1896, and of these there were 252, undoubtedly passed the winter in the Orgyia cocoons and mainly in the larval stage. They were plainly smaller on the average than specimens reared in the following midsummer and the previous September. No observations were made during the winter of 1895–96 which would determine the actual condition in which the insect passes the winter, this statement depending upon observations made during the middle of December, 1896. On December 10, 1896, several cocoons of the Orgyia were opened and in some of them a number of specimens of this larva were discovered, in one instance as many as six. All were approximately of equal size and were apparently little more than half grown as compared with full-grown larvæ taken in late August and early September. They were, however, much contracted. Instead of being fusiform in shape, as are the full-grown summer larvæ, they were broad oval, the broadest portion a little behind the middle of the body. At the same time, however, their greatest diameter did not exceed that of the late summer fusiform larvæ. In spite of the smaller size, however, these larvæ must be full grown, since each was inclosed in its characteristic cocoon. One of these larvæ is shown at fig. 1*b*, and its size line should be compared with that of fig. 1*a*, which represents a September larva. The small size of the hibernating larva is remarkable and is unquestionably almost entirely due to contraction, as is evidenced by the shortness of the body segments and by the somewhat serrated margin and by the fact that both the head and anal end are well drawn in. In color these hibernating larvæ are of a brighter and lighter yellow than those taken in late summer, and it can plainly be seen that there is a greater quantity of adipose tissue. It is worthy of remark that in the Orgyia cocoon containing six cocoons and hibernating larvæ of the Pimpla there was also a single adult male of the Pimpla. It is doubtful that this individual was the offspring of a prior oviposition, and it was probably simply a rapidly developing individual from the same batch of eggs. Exact observations have not been made upon this point, but it is likely that, as is the case with rapidly developing and externally feeding larvæ of Euplectrus, as shown by Schwarz, the removal of an individual larva far in advance of the others results in the death of the remainder, probably through the admission of air to the wound and the consequent severe inflammation of the host.

Observations upon the method of hibernation of Ichneumonids are sufficiently rare to render this observation on the hibernating larvæ of some positive value.[1]

[1] Forstmeister Tischbein, in Entomologische Nachrichten, 1871, pages 155–160, shows that with the genera Ichneumon, Amblyteles, Dicælotus, Æthecerus, Herpostomus, Heterischus, and Phæogenes, the females (presumably fertilized) hibernate as a rule as adults, the males dying in autumn. He did not determine by microscopic examination whether these overwintering females were fertilized.

We have just called attention to the fact that there were two spring periods of abundance in the emergence of the adults, viz, from March 9 to 26 and from April 10 to 20. The significance of this apparent periodicity is not that it means the development of a second generation, but that there occurred late in March and early in April, 1896, a cold spell which interrupted the issuing of hibernating individuals. As a matter of fact, there was no appropriate food for the development of an abundant generation of the parasite at this time of the year, since the tussock-moth eggs were only just about to hatch and other possible hosts hibernating as half or full grown larvæ or as pupæ were not abundant.

The exact length of time which the parasite remains in hibernating quarters is longer, perhaps, than would be anticipated, as is indicated by the fact that a number of the early March individuals, and, in fact, all of those which issued up to and including the 9th of this month, came out of cocoons collected September 6, 1895, thus giving a resting period of practically six months. Those issuing later than March and in April emerged from cocoons taken from the trees in the spring of 1896, but which were spun the previous September and October.

It will be noticed that a number of specimens issued during November. Whether these individuals successfully hibernated in the adult condition or whether the occurrence of a warm sunshiny day induced them to oviposit in hibernating pupæ of the Orgyia (and we know from observations that, although the spun-up larva is their favorite condition of the host, they will often oviposit upon pupæ) is a matter which we have not decided from exact observation. We know that certain Ichneumonids do successfully hibernate as adults and that there is this possibility with this species. It is safe to say, however, that the normal hibernating condition is that of the larva after its cocoon has been spun.

All the hibernating cocoons examined were readily distinguished by a closer, tougher, and more parchment-like consistency. There was less of the more loosely spun outer silk, although there was usually more or less of this looser silk surrounding apparently the whole mass of Pimpla cocoons in any given Orgyia cocoon.

The breeding season of the insect at Washington, then, extends from April to October. We have shown that a single generation may be produced in fifteen days, and with plenty of larval food in the proper condition there would be a possible development of about ten annual generations. As a matter of fact, if we were to consider the Orgyia as its sole food the development of the possible early generations at least would be sadly interfered with by the lack of hosts. The caterpillars of the first generation do not begin to spin up before July, and the confusion of generations of the host insect, owing to the retardation in development of some individuals and the acceleration in others, does not begin to take place in any marked degree until after this

month. There are other insects, however, in the early part of the season upon which the Pimplas do oviposit; yet it is doubtful whether under any circumstances there are more than six or seven generations annually.

As abundant and as hardy as this species seems to be, it does not escape the attacks of enemies of its own. A specimen of *Euschistus servus* was observed to capture an adult female of this Pimpla when she was engaged in oviposition. At least two secondary parasites have been reared from its cocoons, viz, *Dibrachys boucheanus* and *Allocota thyridopterigis*, and it is altogether likely that one or more of the other hyperparasites mentioned will feed upon this species. It has a distinct friend, however, in *Asecodes albitarsis*, which is parasitic upon its principal enemy, the Dibrachys. Details concerning the three species will be given later.

The completeness of the destruction of the Pimpla by the Dibrachys and by other causes during the latter part of 1896 was surprising. About one cocoon in forty contained living Pimpla larvæ. As illustrating a common condition of affairs in December, the result of a careful examination of a bunch of thirteen cocoons of Pimpla found within a single cocoon of Orgyia collected December 14 is here given:

Cocoon No. 1 contained dry fragments of the Pimpla larva, four full-grown larvæ of *Dibrachys boucheanus*, three larvæ just transforming (having already voided the meconium) and one pupa of the same.

Cocoon No. 2 contained a dried-up larva of the Pimpla and its meconial grains.

Cocoon No. 3 contained the rotten body of a Pimpla larva.

Cocoon No. 4 had a small hole in its side and shriveled and mutilated remains of Pimpla larva, the meconium grains and pupal exuvia of a number of specimens of the Dibrachys.

Cocoon No. 5 contained shriveled larval skin of Pimpla and white meconial grains.

Cocoon No. 6 contained rotten body of Pimpla larva.

Cocoon No. 7 had a small hole and contained one pupa skin of Dibrachys, one sound pupa of same, five masses of Dibrachys meconial grains, a fragment of skin of a Pimpla larva, and two larvæ of a dipterous insect, probably the little scavenger fly, *Gaurax anchora*.

Cocoon No. 8 contained a developed but contracted and somewhat mutilated male of the Pimpla, and seven larvæ and four pupæ of the Dibrachys.

Cocoon No. 9 was very thin and not completed; contained shriveled body of a Pimpla larva which had died before finishing its cocoon.

Cocoon No. 10 contained a bit of Pimpla skin and fragments of an unknown pupa, the adult of which had issued through a hole in the Pimpla cocoon.

Cocoon No. 11, same contents as No. 10.

Cocoon No. 12 contained four larvæ and two pupæ of the Dibrachys and a strip of Pimpla skin.

Cocoon No. 13 contained a shriveled and mutilated male pupa of the Pimpla and six larvæ and one pupa of the Dibrachys.

Very many more Pimpla cocoons were opened at this time, but the above is typical of nearly all and includes all of the characteristics except that at rare intervals a hibernating and healthy Pimpla larva would be found, or rather a cocoon mass all containing healthy larvæ, for, in general, the conditions were about the same in each mass.

Pimpla annulipes Say.

This species, which is also an important and widespread parasite of lepidopterous larvæ, and which is particularly noted as perhaps the most efficient enemy of the codling moth in certain parts of the United States, is also a parasite of the Orgyia, although a very insignificant one, at least during 1895–96, when compared with the species which we have just considered. It occurs in California, Texas, Missouri, Michigan, New York, Maryland, Illinois, and the District of Columbia, and probably has about the same distribution as *Pimpla inquisitor*. It is normally a somewhat larger species and is readily distinguished by the remarkably distinct and complete black bands on the tarsi and tibiæ. It has previously been reared not only from the codling moth,

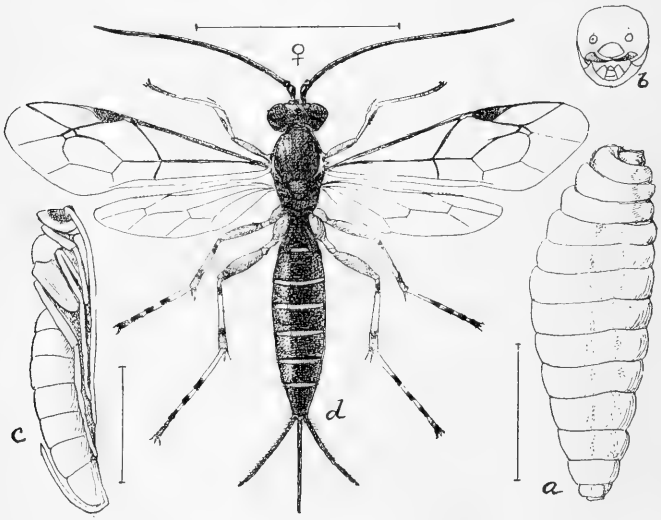

FIG. 5.—*Pimpla conquisitor*: *a*, larva; *b*, head of same; *c*, pupa; *d*, adult female—all enlarged (*d* original, *a*, *b*, *c* redrawn from Fourth Report U. S. Entom. Com.).

as above stated, but also from several Crambids, Tortricids, and Phycitids, as well as from *Papilio ajax* and *Datana ministra*. In March, 1890, it was bred from overwintering cocoons of *Orgyia leucostigma* received from M. H. Beckwith, Newark, Del., and in the course of the extensive rearing experiments of 1895 six specimens issued from cocoons of the tussock moth between September 16 and 25. Its life history is probably very similar to that of *P. inquisitor*.

Pimpla conquisitor Say.

This widespread and abundant Pimpla is one of the most important parasites of the cotton worm of the Southern States, *Aletia argillacea*. It is also parasitic upon the bagworm in New Jersey and the District of Columbia and is an important parasite of Phryganidea in California.

It has also been reared from the tent caterpillar of the orchard (*Clisiocampa americana*), from the melon worm of the South (*Phakellura hyalinata*), and other Lepidoptera of economic importance. The species is found from California to New Jersey and south to the Gulf of Mexico. Cresson also records it from Canada.

With the cotton worm, the larva of which is slender, this large parasite issues only from the chrysalis, so far as we know. With the tussock moth, however, it is the larva which is parasitized. Fig. 6 shows admirably the appearance of a full-grown caterpillar from which the larva of this Pimpla has emerged and spun its cocoon. The cocoon is too big to be contained within the larval skin, which therefore splits longitudinally along the venter and serves simply as a dorsal cap. The only specimen at hand which has been reared from this particular host was collected in the condition shown in the figure by Mr. Coquillett, at Chestertown, Md., October 30, 1895. It was brought to Washington, and from it the adult issued from the orifice shown at fig. 6 on December 7. This would seem to indicate a hibernation in the imago stage, but it is quite possible that the emergence was premature, owing to the artificial temperature of the room in which it was kept, and that under normal conditions the hibernation would have been within the cocoon.

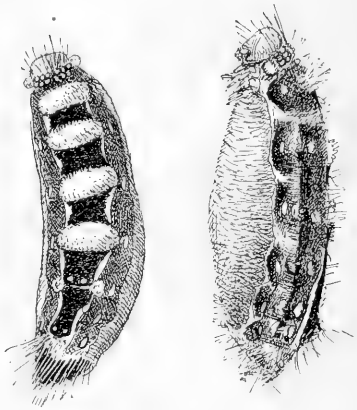

FIG. 6.—*Pimpla conquisitor:* Two views of cocoon under skin of tussock moth caterpillar—enlarged (original).

The figures of the early stages (fig. 5 *a*, *b*, *c*) have been enlarged from those published in the Fourth Report of the United States Entomological Commission, at page 112, and the larval mouth parts are probably incorrect. The adult, however, was drawn from the specimen issuing from the cocoon above referred to. The species may at a glance be distinguished from either of the other Pimplas above mentioned by the narrow yellow bands on the dorsum of the abdomen.

The occurrence of the large cocoon in this instance is very interesting, since, when it infests the chrysalis of *Aletia argillacea* as well as the pupæ of other species, this parasite not only makes no cocoon, but spins no silk. A number of empty pupæ of Aletia from which *Pimpla conquisitor* had emerged have recently been examined with this point in view, and no trace of silk could be found. Very many specimens were reared from the chrysalids of this host during the cotton-worm investigation. Most of them issued in the spring, but some made their appearance in the late autumn.

Amorphota orgyiæ n. sp.[1]

The interesting little Ichneumon flies allied to the genus Campoplex (Campoplegini) are general and widespread parasites of lepidopterous larvæ. They have been seldom reared in the United States, although something over twenty species of the old genus Campoplex are known to occur in this country. Those which have been reared have come from larvæ of Noctuidæ or Bombycidæ, while in Europe they are known to attack the larvæ of these two families as well as many species of Geometridæ. Two species of Orgyia in Europe are attacked by them, viz, *Orgyia gonostigma* by *Campoplex carbonarius* and *O. antiqua* by *C. nigripes*.

FIG. 7.—*Amorphota orgyiæ:* Adult female above, with its cocoon and shrivelled skin of the caterpillar host below—enlarged (original).

The species under consideration lays its eggs in the half-grown caterpillars of *O. leucostigma*. Probably but a single egg is laid in each caterpillar, since but a single larva of the Amorphota is found to issue. It was noticed that in August, 1895, a number of the half-grown larvæ had been parasitized by this species. The development of the parasitic larva was undoubtedly rapid, although no definite observations were made which would determine its length. Upon reaching full growth the parasitic larva invariably leaves the Orgyia caterpillar, usually issuing from a large hole on the underside of the body behind the thoracic segments, and beginning immediately to spin at its posterior extremity a stoutish white cocoon marked near each end by a ring of large irregular brown blotches. The color of these blotches varies in intensity from a light yellow brown to a dark mahogany brown, and their size, and particularly their shape, is also variable. In addition to these bands there are smaller irregular blotches at either end of the cocoon. This cocoon is attached by its side to the leaf or bark upon which the caterpillar happens to have been crawling. This attachment is not especially firm, and the parasitic larva apparently makes no special effort to attach it, and it probably adheres simply through the viscidity of the silk when first spun. The cocoon is, however, frequently somewhat flattened on the side. In general it is subcylindrical in shape, with rounded ends, its average length being 6 mm. and its diameter 2.3 mm.

[1] This, with the other new species, will be described in an appendix. (See page 53.)

The discarded skin of the caterpillar host is slightly or not at all attached to the cocoon or to the leaf or bark by the parasitic larva. It is usually blown away by the wind in a short time, but sometimes remains attached by its prolegs, or perhaps by silk which it spun before its death, to the leaf or bark upon which it happens to be at the time, so that the appearance shown in fig. 7 is frequently observed.

Observations made in late August seem to indicate that the period from the completion of the cocoon to the issuing of the adult insect is only from seven to ten days. Four specimens of the adult were reared altogether. These issued two on August 29, one on September 17, and another on September 21. The remainder of the cocoons just referred to as having been more or less numerous gave out secondary parasites, the most abundant being *Spilochalcis debilis*, which will be treated more or less in detail in a later paragraph.

The Amorphota in issuing from its cocoon gnaws an irregular roundish hole at one extremity, of perhaps two-thirds the diameter of the cocoon itself, but if a cap is thus removed it does not remain attached by a hinge and has not been observed. The orifice in none of the cases noticed was made at the center of the tip, but a trifle to one side, as shown in fig. 7, presenting almost the appearance of having been pierced by a hyperparasite.

FIG. 8.—*Meteorus communis:* Adult female from side, with empty cocoon showing cap—enlarged (original.)

Meteorus communis Cresson.

This common and widespread species was a more or less important factor in the reduction of the numbers of the tussock-moth caterpillars in the early autumn of 1895, and would doubtless have been a still more important factor in the early summer of 1896 were it not for the fact that in the autumn of 1895 it was attacked by secondary parasites to such an extent that in 1896 not a single specimen was found or reared! This insect, which belongs to the family Braconidæ (whereas the others previously considered belong to the Ichneumonidæ), is recorded by Cresson from Canada, Connecticut, and New Jersey, and occurs in the National Museum from Texas, Missouri, and the District of Columbia. It has been reared from Tineids, Botids, and Bombycids, and with *Orgyia leucostigma* attacks the half-grown larvæ in much the same manner as does the Amorphota previously described. The parasitic larva issuing from the body of the half-grown caterpillar, which immediately becomes shriveled and distorted, spins for itself an oval cocoon of tough, parchment-like brown silk, over the surface of which are scattered threads of a coarser and lighter-colored silk. The toughness and

elasticity of these cocoons is extraordinary. It is almost impossible to open them without destroying their contents unless they are previously softened. The end from which the adult subsequently issues is the more pointed, and is usually lighter in color than the rest of the cocoon. The cocoon itself is attached to the leaf or bark by the coarser threads at the opposite end, and frequently this attachment is of such a nature that the cocoon hangs to a distance of several millimeters from its point of attachment. In issuing, the adult cuts off an even lid at the smaller end of the cocoon, the lid remaining attached by the coarser outer threads just mentioned as by a loose hinge. The dimensions of the cocoon are: Length, 4.8 mm.; greatest diameter, 2.2 mm. The period of development of this insect appears to be rapid, although we are able to give no definite figures. The larval development certainly takes place in less than ten days, while in early autumn the pupa stage seems to vary from ten to twenty days. Owing to the extensive secondary parasitism, the method of hibernation was not ascertained. Adults were reared September 19 to 23, but from the cocoons kept later in the season there issued only secondary parasites. *Spilochalcis debilis*, the hyperparasite mentioned in connection with the Amorphota, is also the most important enemy of this species.

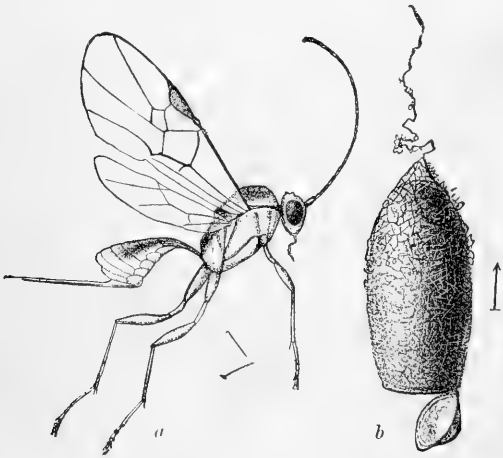

FIG. 9—*Meteorus hyphantriæ*: *a*, adult female from side; *b*, empty cocoon showing cap—enlarged (from Bull. 10, Div. Entom. U. S. Dept. Agr.).

Meteorus hyphantriæ Riley.

A single specimen of this common parasite of *Hyphantria cunea*, described by Riley in Bulletin No. 10 of this Division, was reared September 23, 1895, from *Orgyia leucostigma*. The cocoon of this species is somewhat larger and of a darker brown than that of *Meteorus communis*, and it hangs suspended by a long strand of silk, as is well shown in fig. 24, Bulletin 10, here reproduced. In 1886, the great webworm year in the District of Columbia, this species was very abundant. According to observations made that year, ten days elapsed between the completion of the cocoon and the emergence of the adult, and it was found that a majority of the adults had issued by November 1, making it probable that the insect hibernates in the adult condition. With this species in 1886, as with the *M. communis* in 1895, secondary parasitism was very marked. Out of 450 cocoons of the Meteorus placed in a glass jar the latter part of September only 70 adults issued, the remainder giving

out secondary parasites. Thus only 16 per cent of the cocoons produced the species which made them, while 84 per cent were parasitized.

Mr. Slingerland has recently reared this species in New York from *Xylina laticinerea*, and it is probably or may become a general parasite of free living lepidopterous larvæ.

Limneria valida Cresson.

This species, which is also a parasite of *Hyphantria cunea*, was one of the unimportant primary parasites of the Orgyia. It was not reared in 1895, but made its appearance among the rearings of July, 1896. It issued from collected cocoons of the Orgyia, and but three adults were reared, all issuing July 17, 1896. This apparent scarceness of the species was only apparent, however, for many of its empty cocoons were found among the cocoon masses of the Orgyia the following December. The cocoon is rather long ellipsoidal, averaging 7.5 mm. in length by 2.8 mm. in greatest diameter. It is composed of two distinct coverings, the outer one of weak, close-spun, crinkly, gray or grayish-brown silk, readily peeling off in a sheet, and the inner one close, tough, parchment-like, dark brown in color, with golden reflections, of the type common among the Ophioninæ. The adult issues from a round hole without a cap, gnawed almost precisely at one end, and, judging from the evidence at hand, hibernates as an imago. At all events, of the many cocoons examined December 14 to 17, 1896, all were empty. All of the cocoons found at this date were associated with spun-up larvæ of the Orgyia, and none with the pupæ of this insect. In one instance a single Orgyia cocoon contained three of *Pimpla inquisitor*, all empty, and one cocoon of this Limneria, from which a hyperparasite had evidently emerged.

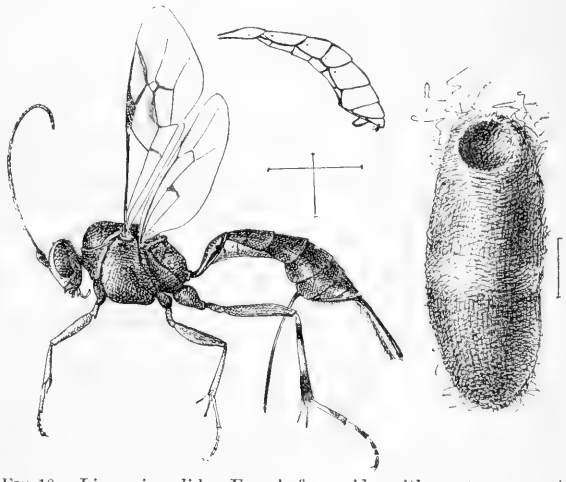

FIG. 10.—*Limneria valida:* Female from side, with empty cocoon at right, and male abdomen above—enlarged (original).

Limneria sp.

An allied and congeneric species issued in a single specimen on July 16, 1896. Its abdomen was unfortunately broken off, and the specimen was otherwise damaged to such an extent as to render it of uncertain specific position.

Theronia fulvescens Brullé.

A single male of this species issued from a mass of Orgyia cocoons on July 24, 1896. It is a species which was originally described from Colorado, but which is more or less common in the Eastern States. It has not previously been associated with its host, so far as we know.

Apanteles delicatus n. sp.[1]

The small white cocoons of this species, occurring singly, attached to the bark of trees over which Orgyia larvæ were crawling, were reasonably abundant in September, 1895, and in the autumn of 1896. This species again was greatly hindered in its beneficial work by the abundance of secondary parasites, so much so that but four specimens of the adult have been reared. These specimens hibernated within their cocoons and issued in March and April, 1896, from cocoons collected September 9 and 10, 1895. From other cocoons collected at the same time issued specimens of *Dibrachys boucheanus* and *Spilochalcis debilis*. A number of these cocoons were collected and opened December 14, 1896, for the purpose of ascertaining whether the parasite hibernates within its cocoon as larva or as pupa, but all, with a single exception, instead of the original constructor of the cocoon, contained hyperparasites. Of these the most abundant was *Elasmus atratus*, which seems to be a very destructive enemy of this species. From two to four of its pupæ were found in nearly every Apanteles cocoon examined. In one, however, were two larvæ of *Dibrachys boucheanus*, and the single exception referred to contained a dead adult of the Apanteles.

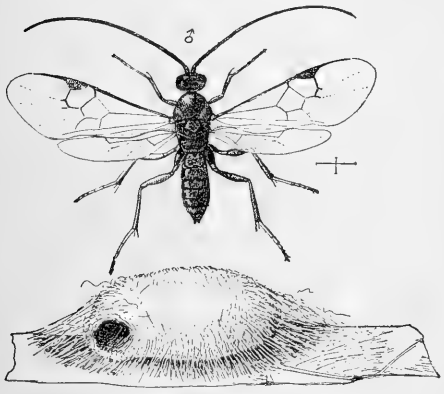

FIG. 11.—*Apanteles delicatus:* Adult male, with empty cocoon below—enlarged (original).

On September 10, 1895, the writer saw a nymph of *Podisus spinosus* trying to penetrate a cocoon of the Apanteles with its beak; but, although watched for some minutes, it was unsuccessful, and crawled away in search of some easier prey.

Apanteles hyphantriæ Riley.

This species, which is an extremely common and important parasite of *Hyphantria cunea*, was mentioned in Bulletin No. 10 of this division, pages 53, 54. It made its appearance early in the season of 1886, and attacked only half-grown caterpillars of the web worm. During the

[1] Described in the appendix, page 55.

autumn its cocoons were found to contain, in the main, secondary parasites. When affecting Hyphantria, the white silken cocoon is formed almost under the middle of the half-grown caterpillar, and is fastened securely to the object its host happens to rest upon and slightly to the host itself, which is, however, readily carried to the ground by wind and rain, and can therefore only be found in position in the more sheltered places, such as cracks in the bark of trees. But one Apanteles is found in a caterpillar, so that each white cocoon indicates the death of a victim. The cocoon of this species is readily distinguished from that of the foregoing species by its denser consistency, its apparently tougher silk, and greater opacity. The cocoon of *Apanteles delicatus* is, moreover, more firmly attached to the bark of the tree upon which the host insect has been feeding and by a greater number of attaching threads, as shown in fig. 11.

In the summer of 1895, as will be noted later, the larvæ of the fall webworm were frequently found (usually in the half-grown condition) wandering about the trunks of trees affected by the Orgyia, this peculiar condition of affairs resulting mainly from the destruction of the food supply by the very unusual numbers of tussock-moth caterpillars. *Apanteles hyphantriæ* was very abundant, and a large proportion of these wandering, unprotected half-grown webworms were stung by this species. It happened in a number of cases that tussock-moth caterpillars of a corresponding stage of growth were also stung, and it can definitely be said that this Apanteles, while apparently preferring the webworm, is also a true primary parasite on occasion of the tussock-moth caterpillar. Its habits when attacking this latter host are similar to those just described. Its cocoons were abundant upon the tree trunks during the winter of 1896–97, and examination showed that they were almost without exception infested by hyperparasites. Among these were recognized *Elasmus atratus* (by far the most abundant), *Dibrachys boucheanus*, and *Spilochalcis debilis*. *Asecodes albitarsus* was also in one case reared from a cocoon which had been infested by *Dibrachys boucheanus*.

Chalcis ovata Say.

This widespread species, which is found all over the United States and Canada, and which also extends into the West Indies, is a very general parasite of Lepidoptera, issuing as a rule from their pupæ. The writer in 1885 (Bulletin No. 5, Division of Entomology) recorded it as having been reared from pupæ of *Thyridopteryx ephemeræformis*, *Apatura clyton*, *Aletia argillacea*, *Desmia maculalis*, *Cacœcia rosaceana*, *Gelechia gallæ-solidaginis*, and *Botis alnialis*. It is rarely parasitic on the fall webworm (*Hyphantria cunea*), but is the most important of the primary parasites of the tussock-moth caterpillar next to *Pimpla inquisitor*.

It was first observed ovipositing in the tussock-moth cocoons on September 7, 1895, when the writer observed it in some numbers flying

about the trees defoliated by the caterpillars of this insect. A female of the Chalcis was watched while engaged in ovipositing in a fresh chrysalis. She flew around the trunk of the tree, examining one cocoon after another, perhaps six in all, until she found a male cocoon containing a freshly transformed pupa. This cocoon she felt over from one end to the other, her antennæ constantly vibrating. Finally she inserted her ovipositor, withdrawing it after a few seconds, then inserted it again and again a third time. At the fourth insertion she apparently penetrated to the right spot, for she forced her ovipositor through the silk, hugging the cocoon close and pushing her abdomen as close as possible to the pupa. In this position she remained two and a half minutes, finally withdrawing her ovipositor, walking to the upper end of the cocoon and remaining for a minute or two actively cleaning her legs and antennæ, rubbing them against each other for some time, after which she was captured. The pupa which had been stung was placed in a vial, and from it on September 14 there issued a healthy male moth. We can not surmise the cause of failure of this apparently successful oviposition on the part of the parasite. On September 10 another specimen was observed ovipositing in a pupa which was evidently several days old and which bore signs of having been previously parasitized. This second pupa was preserved, but did not give out an adult parasite. It died and dried up. Another specimen was observed ovipositing in a shrunken larva which bore a Tachinid egg on the dorsum of the sixth abdominal segment. The movements of a large dipterous larva could be seen through the skin of the caterpillar. This specimen also was placed in a vial, but eventually dried up and no parasite issued. The two adult specimens observed ovipositing on the 10th were placed in vials with cotton stoppers and on the 11th were still alive and active. They were removed to different tubes and provided with pupæ of the tussock moth in an advanced state of development. One of them oviposited in the same pupa twice and the other once. On the following day (September 12) both died. On the 13th the moth issued from one of the pupæ oviposited in on the

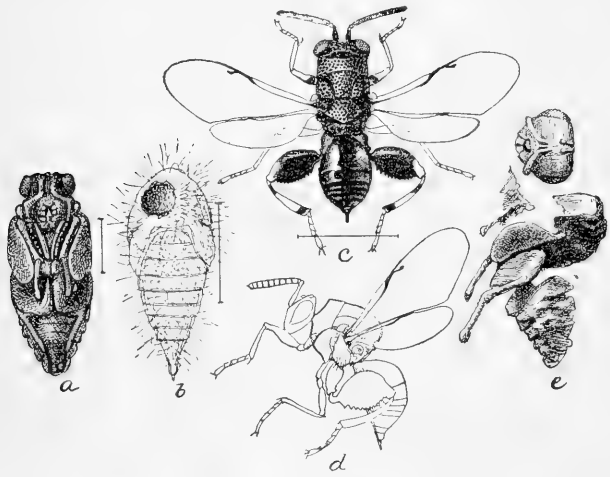

FIG. 12.—*Chalcis ovata*: *a*, pupa; *b*, parasitized pupa of Orgyia; *c*, adult; *d*, outline of same from side; *e*, pupal exuvium—enlarged (original).

11th, the egg of the parasite having been laid too late to interfere with the development of the adult Orgyia, or perhaps the already greatly toughened skin of the pupa was not penetrated by the ovipositor of the Chalcis.

Owing to the failure to rear parasites from pupæ or larvæ in which the adults were observed to oviposit, the length of the life round can only be surmised. It is unquestionably, however, very short. The tussock-moth caterpillars were transforming to pupæ rather rapidly at the end of the first week in September, and, as just noticed, the Chalcis flies were abundant at this time, and were actively engaged in ovipositing The first adult of the parasite was reared on September 17 from a discolored pupa found September 13. The second one issued on the 18th from a discolored pupa taken on the 17th, and the third on the 19th from a pupa taken on the 4th. The longest period under observation in the fall of 1895 occurred in the case of certain cocoons taken on August 23, from which the majority of the Chalcis flies issued from the 19th to the 25th September, and from which a very few belated individuals issued as late as October 19. The probabilities are that at this time of the year the entire life round of the parasite occupies on an average from three to four weeks. A little later it is naturally lengthened. From the mass of cocoons taken September 10 the last Chalcis issued October 4.

In issuing from the Orgyia pupa this Chalcis invariably gnaws a hole through the dorsum of the first and second thoracic segments. This hole is usually a little to one side of the median line.

It is an easy matter to recognize the Orgyia pupæ which have been parasitized by this species. Not only is the large round hole near the head of the pupa characteristic of *Chalcis ovata*—that is to say, characteristic among the parasites of the tussock moth—but if the chrysalis be broken open the pupal exuvium of the Chalcis will always be found, and this is in itself so characteristic as to be recognized at a glance. The sheaths of the large hind femora and those of the corresponding tibiæ and tarsi projecting straight out at nearly right angles from the femora distinguish this exuvium from that of any of the other parasites. It is well shown at fig. 12 *e*. Very many of these parasitized pupæ of the Orgyia were examined. Never more than a single pupal exuvium of the Chalcis was found. If more than a single specimen develops in a single Orgyia pupa, it has not been observed. This is rather strange, for it is seldom that the entire contents of the body of the pupa are devoured by this parasite, and in many female pupæ from which an adult Chalcis had emerged fully one half of the eggs were undisturbed and sound.

No instances have been recorded in which this insect seemed to be hyperparasitic, but there was in the collection a swollen larval skin of an Orgyia caterpillar apparently parasitized by some other insect, from which had issued from the anterior ventral segment a specimen of this Chalcis, according to the label. The specimen was carefully dissected

and was found to contain a dipterous puparium about the size of that of *Exorista griseomicans*, and from a hole in its anterior end some insect had emerged. No trace of the pupa skin of the Chalcis could be found, however, and I am of the opinion that the label was incorrect.

In all, 260 specimens of *Chalcis ovata* were reared, and dates of issuance will appear from the following table:

Date.	Number.	Date.	Number.	Date.	Number.	Date.	Number.
1895.		1895.		1895.		1896.	
Sept. 17	3	Sept. 30	2	Oct. 17	1	July 20	2
18	3	Oct. 1	1	19	1	21	7
19	14	2	3	26	1	23	7
20	14	3	1	1896.		24	3
21	22	4	3	July 11	1	25	7
23	39	7	1	13	1	27	5
24	18	8	3	14	3	28	8
25	24	9	1	15	4	29	5
26	18	11	1	16	8	30	2
27	8	15	1	17	3		
28	5	16	3	18	3	Total	260

It will be observed from this table that no rearings were made in the spring of 1896 from cocoons taken the previous fall or from cocoons taken in the early spring. From this fact it seems reasonably certain that this insect hibernates in the adult condition.

We have no positive evidence that it possesses secondary parasites, but specimens of *Dibrachys boucheanus* have been reared from pupæ of the Orgyia, the first inhabitant of which we do not know, but it may very well have been this species.

Pteromalus cuproideus n. sp.[1]

On October 5, 1895, two specimens of this parasite were reared from the 100 Orgyia cocoons collected September 10 to ascertain the percentage of parasitism. All of the species belonging to the section of the genus Pteromalus, to which this belongs, are primary parasites on lepidopterous larvæ, and we may therefore safely consider that this species is a primary parasite of the larva of the tussock moth.

Cratotechus orgyiæ (Fitch).

The adult of this insect has been reared only by Dr. Fitch. In his Second Report on the Noxious, Beneficial, and Other Insects of the State of New York (separate edition, p. 216, 1856) he gives the following account of this insect:

I once gathered two of these caterpillars, which I placed, with some leaves, in a box. Two days afterwards one of them was found to be dead, and the other, being lively and vigorous, was removed to another box. Next day what appeared to be the ends of little worms were seen protruding from the body of the dead caterpillar. Upon the following day these worms were found to be seventeen in number. They had all left the dead carcass of the caterpillar, and just above it on the side of the box

[1] Described in the appendix, page 55.

they had arranged themselves in a circular row and had changed to pupæ of a milk-white color, 0.12 [inch] long and half as broad, hanging by their tails, with their heads downward and their backs against the side of the box. This was upon the last day of July. Next day they had changed to a pale red color and had somewhat shriveled, each having discharged a little cluster of clay-yellow grains, which were adhering to the side of the box at the tip of their bodies. They subsequently altered to a black color, and on the 6th of August they hatched the winged insects, which were of a brilliant brassy-green color, with a blackish-purple abdomen and white legs, and about the same size as the pupæ.

Both Dr. Fitch's account of the method of transformation and an examination of the fragmentary specimens still remaining in his collection, now in the possession of the United States National Museum, indicate that this parasite belongs to the genus Cratotechus.

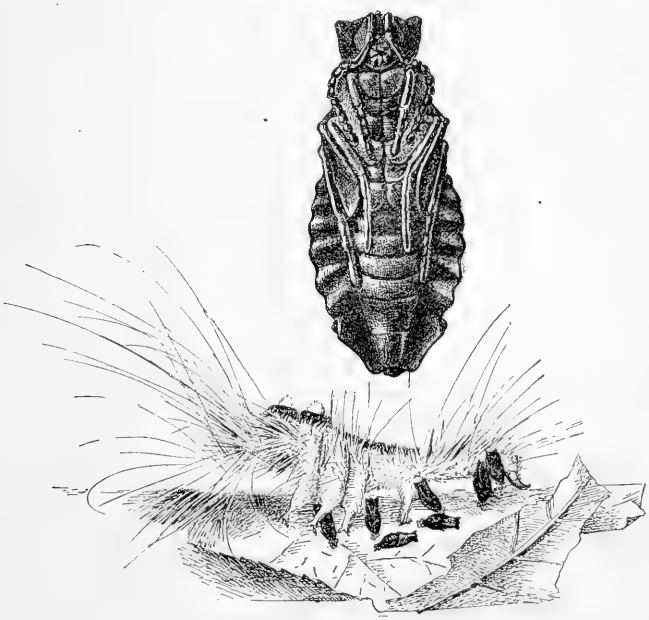

FIG. 13.—*Cratotechus orgyiæ:* Pupæ *in situ* below, with greatly enlarged pupa above (original).

In December, 1896, a few specimens of the pupæ of a Cratotechus or some closely allied Eulophine genus were found among the cocoons of an Orgyia, and we assume that they belong to this species. Efforts to rear the adult, however, have failed up to the time of writing since all, or nearly all, had been stung by a hyperparasite—*Elachistus cacœciæ*. A group of seven of these pupæ attached to a leaf about the shriveled remains of a half-grown Hyphantria larva is shown at fig. 13, while one of the pupæ enlarged is illustrated in the same figure.

These exposed pupæ of Cratotechus are frequently in other instances parasitized by species of Tetrastichus, and it is possible that the species of this genus reared by Dr. Lintner has for its true host *Cratotechus orgyiæ*.

Ophion bilineatum Say.

This species is mentioned in this connection with, unfortunately, no certainty as to whether it is a parasite of the Orgyia or not. The reason for introducing it is simply that in December, 1896, a single specimen of its easily recognizable cocoon was found in a mass of the Orgyia cocoons and apparently inclosed in the outer envelope of one. The cocoon was opened, but the adult had issued at some previous time. On the whole, it is not likely that it was a parasite of the tussock-moth caterpillar. Ordinarily this species is reared from larger Bombycids, such as the Arctians and Saturnians, and it is quite likely that the larva making this cocoon had issued from a larva of one of these groups, had spun its cocoon upon the bark of the tree where it was subsequently found, and had afterwards been spun over by the Orgyia larvæ in making their own cocoons.

Ichneumon subcyaneus Cresson.

This species was observed in September investigating full-grown larvæ and recently spun cocoons of the Orgyia. The writer watched several specimens, and has little doubt that it may be put down as a parasite of this species, although no specimens were actually reared. It is a widespread species recorded from Canada and generally throughout the United States, and is said to have been reared from several Bombycids, as well as from *Nematus ventralis*.

Ichneumon cœruleus Cresson.

The same statement may be made regarding this species. It was observed in September, 1895, under exactly similar circumstances, and has practically the same distribution, but has been reared only from pupæ of Bombycids.

TELENOMUS EGG PARASITES REARED FROM OTHER SPECIES OF ORGYIA.

Telenomus californicus Ashmead.—There are four female specimens of this genus in the collection of the United States National Museum, which were reared by Mr. Ehrhorn from an egg mass of a species of Orgyia at Mountain View, Cal.

Telenomus orgyiæ Fitch.—This minute egg parasite issues from the egg mass of the closely allied *Orgyia nova*. With this insect the eggs are left naked and not covered with the white, frothy substance with which the female of *O. leucostigma* covers and hides her eggs. It may result from this fact that this parasite will not be reared from the egg mass of the species of Orgyia under consideration. It has been reared from the eggs of a species of Orgyia at Ottawa, Canada, by Mr. W. H. Harrington, as well as by Dr. Fitch in New York. The species referred

to on page 34, second edition Bulletin No. 10 of this division, is probably *T. orgyiæ*, but we are unable to substantiate the statement that it has been reared from eggs of *O. leucostigma*.

Hemiteles townsendi Ashmead.

With the consideration of this species we begin the hyperparasites, leaving the primary dipterous parasites to be considered after all of the Hymenoptera have been treated. So far as known, all of the species of Hemiteles, as well as of at least most of the genera into which it was subdivided by Foerster, are hyperparasites. They are reared from all sorts of lepidopterous larvæ and pupæ, from dipterous puparia, from oak galls, and from spider cocoons, but in every case, so far as the published records go, where the exact host relationships have been determined, they have been found to be hyperparasitic. There is a species, however, at Washington which is very deceptive in this regard. It issues from the egg cocoons of certain spiders, and a close examination of the cocoons from which it issues fails to show even the fragmentary remains of a primary parasite.

In the case of the present species (*Hemiteles townsendi*) no such difficulty exists. The type specimen was collected in Michigan by Mr. Townsend, and in December, 1889, another specimen was reared from the puparium of a dipterous insect at Washington. There have been four specimens reared from the cocoons of the tussock moth. All four issued in early November, 1895, and it is practically safe to say that they came from contained puparia of one of the Tachinid parasites of this insect. Of the four specimens, three are females and one is male.

Bathythrix meteori n. sp.[1]

A number of specimens of a very distinct Hemiteline were reared during 1896. The first specimen issued March 5 from a cocoon of *Meteorus communis*, collected in December, 1895. All of the others, thirteen in number, issued between July 21 and August 5, 1896, from the mass of 624 cocoons of the Orgyia collected between June 30 and July 8, 1896. It is worthy of remark that not a single specimen of the Meteorus was reared from this lot of cocoons. Of the thirteen specimens, eight were females and five males.

Bathythrix pimplæ n. sp.[2]

Four specimens of this insect were reared August 29, September 18, 28, and 30, 1895, from masses of cocoons of the Orgyia under observation in the rearing cages. Its exact host relationships are not known, but it is probably a parasite of *Pimpla inquisitor*.

[1] Described in the appendix, page 53.

[2] Described in the appendix, page 54.

Adiastola americana n. sp.[1]

Three specimens of this species, two females and one male, were reared November 6, 1895, from cocoon masses of Orgyia under observation. This species also is likely to be a parasite of *Pimpla inquisitor*.

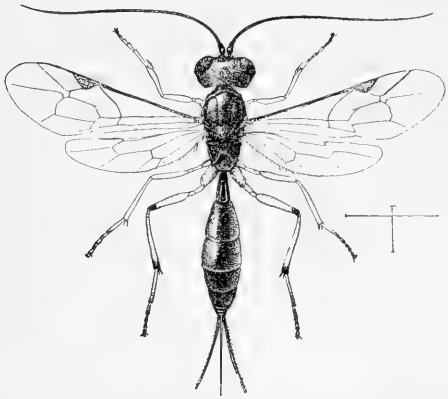

FIG. 14.—*Bathythrix pimplæ:* Female—enlarged (original).

Otacustes periliti Ashm.

A single specimen of this species issued from a cocoon of *Meteorus communis* March 5, 1896, the Meteorus having previously parasitized an Orgyia larva. This species was reared from the same host at Washington in 1882, but has not since been found.

Allocota thyridopterigis (Riley).

A single specimen of this insect, which is commonly reared from the bags of the bagworm and which was first described by Riley as a parasite of this species, was seen crawling rapidly over the trunk of a poplar tree in September, 1895, investigating Orgyia cocoons. It was doubtless attracted by

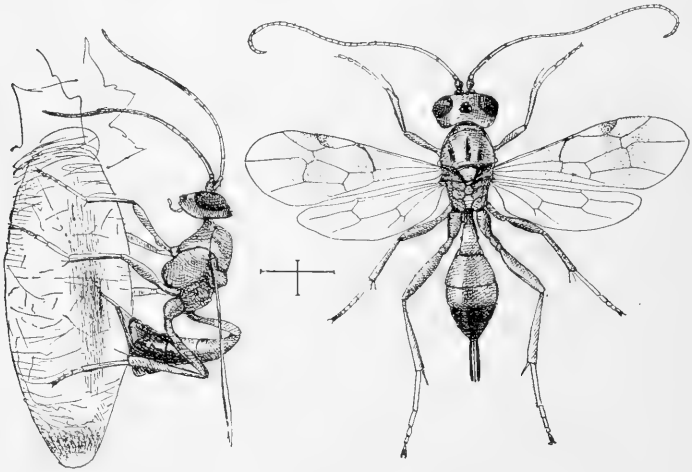

FIG. 15.—*Otacustes periliti:* Female, dorsal view, at right; same, ovipositing in Meteorus cocoon, at left—enlarged (original; the latter from field sketch by Pergande).

the abundance of Pimplas, and as Riley has shown that it is a hyperparasite of *Pimpla conquisitor*, we may safely put it down as a secondary parasite in the case of *Orgyia leucostigma*, the more especially as no

[1]Described in the appendix, page 54.

specimens of the bagworm were noticed in the vicinity. That this species should be attracted to the Pimpla only when contained within the bags of the bagworm would be somewhat of an anomaly.

Pezomachus insolitus n. sp.[1]

The species of the genus Pezomachus may or may not be hyperparasites. The genus somewhat resembles Hemiteles, and there have been published statements to the effect that the two genera are identical, the one comprising the one sex and the other the other sex. These statements, however, are due to a faulty appreciation of the generic characters and to the fact that species of each genus are often reared from the same host, notably from the egg cocoons of spiders. So close an observer as Foerster, as a matter of fact, placed the two genera in

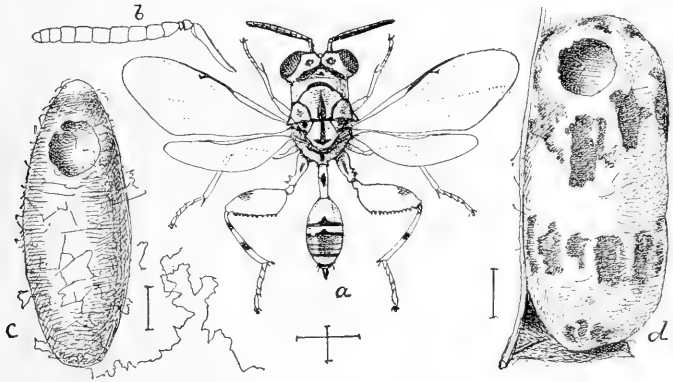

FIG. 16.—*Spilochalcis debilis*: *a*, adult; *b*, antenna of same; *c*, Meteorus cocoon, and *d*, Amorphota cocoon from which this species has issued—enlarged (original).

different families, the one being the type of the Hemiteloidæ and the other of the Pezomachoidæ. Three male specimens of the species under consideration were reared November 9 and 19, 1895, from the cocoon mass of the Orygia.

Spilochalcis debilis (Say).

This beautiful little species, which is recorded by Cresson from Delaware, Indiana, and Illinois, and is also known to the writer to occur in North Carolina and Long Island, New York, has frequently been reared in the course of these investigations. There can be little doubt that some of the species of Spilochalcis are primary parasites of Lepidoptera. Others are with equal certainty hyperparasites. For example, Walsh's *Smicra albifrons*, which belongs to this genus, is with little doubt a tertiary parasite, since it issues from a Pezomachus which is parasitic upon a Microgaster which destroys the army worm (larva of *Leucania unipuncta*).

[1]Described in the appendix, page 54.

The present species is a very important hyperparasite. It was extensively reared at this office in 1886 from the cocoons of *Meteorus hyphantriæ* and is the species referred to as *Spilochalcis* sp. on page 57 of the second edition of Bulletin No. 10 of this Division.

During the observations upon Orgyia parasites in 1895–96 it was reared from the cocoons of *Amorphota orgyiæ*, of *Meteorus communis* and *M. hyphantriæ*, and of the two species of Apanteles just considered. Moreover, empty cocoons of *Limneria valida* have been found pierced by holes of about the size of the exit holes made by this species, so that it is very possibly a parasite of this species also. There is a further possibility that it may parasitize *Pimpla inquisitor*, although I have no definite proof.

The cocoons of the Meteorus from which this insect has issued may readily be distinguished from those cocoons from which the Meteorus itself has issued by the fact that the Spilochalcis makes a round hole before the tip and does not cut off the circular hinged cap which is characteristic of the issuing hole of the Meteorus. This appearance is well indicated upon fig. 16. With a lesser degree of certainty, the same distinction may be made with regard to the cocoons of the Amorphota. Here the issuing hole of the true maker of the cocoon is not only considerably larger than that of the Spilochalcis parasite, but it is usually made nearer to the exact end of the cocoon than is that of the parasite. The same may be said of the Apanteles cocoons. It is noticeable that the specimens which issue from the Amorphota cocoons are somewhat larger than those from the Meteorus cocoons, while those from the Apanteles cocoons are still smaller. No observations have been made upon the early stages of this species. The total number of specimens reared is twenty. Fifteen of them issued between September 3 and October 5, 1895; one January 4, 1896, and the others April 20 and 22, 1896. Those issuing in the autumn consisted of both males and females, while those issuing in April were all males, were darker in color, and all came from the cocoons of the Apanteles. These facts suggest a dual hibernation, either as adults or as larvæ or pupæ within the cocoons of the host insect, but it is worthy of remark that no specimens of this insect in any stage were found during the extensive examinations made the middle of December, 1896.

Habrocytus thyridopterigis Ashmead.

This Pteromalid is rather commonly reared from the bags of the bagworm, in which the writer has assumed it to be a tertiary parasite, having for its host Riley's *Hemiteles thyridopterigis*, which in its turn is in all probability parasitic upon *Pimpla conquisitor*, so often found in the bags.[1] Eight specimens only of this species have been reared in the

[1] An observation is recorded in Proc. Ent. Soc. Washington, I, 28, showing that a Chalcidid larva feeds in the bags on the larva of the Hemiteles. This chalcidid is with little doubt *Habrocytus thyridopterigis*.

course of the Orgyia observations, and all practically between April 16 and May 18, 1896, in the jars containing cocoons of the tussock moth collected in March and early April. Of the eight specimens, four were males and four females. The probabilities are this species overwinters within the cocoon of its host. What its true host may be we can only surmise. It is probably one of the Hemitelines parasitic upon *Pimpla inquisitor*.

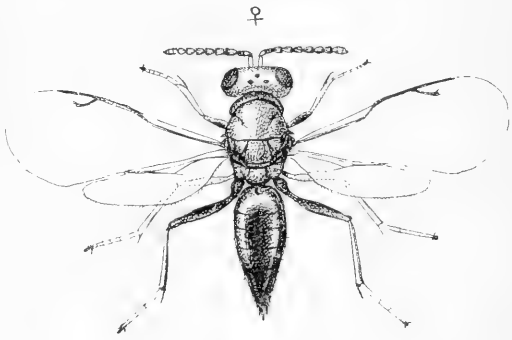

FIG. 17.—*Habrocytus thyridopterigis*—enlarged (original).

Dibrachys boucheanus (Ratzeburg).

This widespread and very abundant hyperparasite is common in Europe, and was frequently reared by Ratzeburg, Brischke, and later observers, from different hosts. Ratzeburg, in the first volume of his Ichneumonen der Frostinsecten, pages 196–197, states that he reared a number of specimens as secondary parasites in the year 1842, at the close of the feeding period of *Liparis dispar* (the gypsy moth). He took many Microgaster cocoons in July of that year from the larvæ of the gypsy moth found dead upon the trees. Hardly half of the Micro-

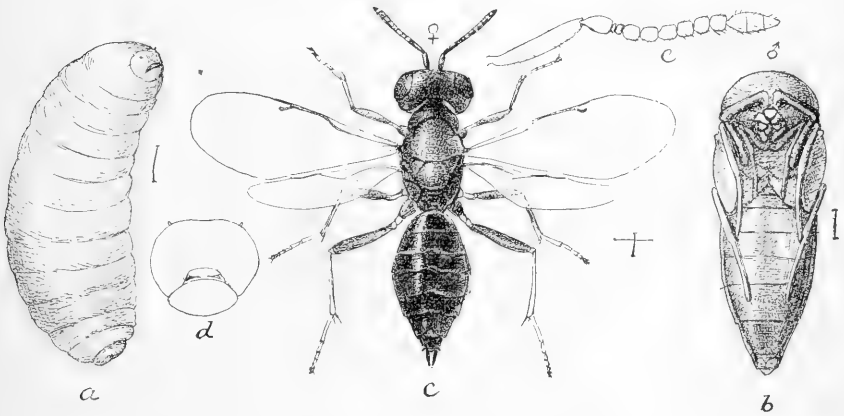

FIG. 18.—*Dibrachys boucheanus*: *a*, larva; *b*, pupa; *c*, adult female—greatly enlarged; *d*, head of larva; *e*, antenna of adult—still more enlarged (original).

gasters issued from these cocoons, the remainder giving forth this hyperparasite, which issued from needle-like holes in the cocoons, the true makers of the cocoons issuing from holes made by cutting off circular caps. He found that in some cases the larvæ of the Microgasters were wholly eaten out by the parasite and prevented from pupating. In other cases the larvæ retained sufficient strength and substance to

transform to pupæ, and were killed in that state by the parasite. In one case he found a Microgaster pupa which had been destroyed by the pupa of a Pteromalid, from which a tertiary parasite, which he considers possibly to have been this species, had emerged. The development of the hyperparasite he found to occur rather late, for on the 18th of December he had living pupæ and adults and even one living larva, although the gypsy-moth larvæ had been killed as far back as the month of July by the Microgasters. In his second volume, pages 189–190, he states that he bred this species in 1847 from Microgaster cocoons from *Bombyx salicis*, and at the same time from hanging cocoons such as Perilitus spins. From neither of these kinds of cocoons did he obtain the true maker, but only this parasite, together with two other secondary species. In his third volume, pages 231–232, he mentions an instance, on the authority of Tischbein, in which this species was probably a tertiary parasite, destroying *Hemiteles socialis*, which itself was parasitic in Microgaster cocoons.

Brischke records the rearing of this species from *Microgaster glomeratus*, *M. fulvipes*, and *Meteorus unicolor*.

Mr. Ashmead, in the course of his careful studies of the Pteromalinæ of the United States, has decided that Fitch's *Cleonymus clisiocampæ*, reared from the chrysalis of *Clisiocampa americana* and stated by Fitch (erroneously, if Mr. Ashmead's determination be correct) to be a primary parasite of this species, is identical with this European species.

It has been reared as a hyperparasite from several insects at this office. It is recorded among the hyperparasites of *Hyphantria cunea*, under the name of Pteromalus sp., in the revised edition of Bulletin No. 10 of this Division as parasitic upon *Apanteles hyphantriæ*, *Meteorus hyphantriæ*, and *Limneria pallipes* (= *valida*).

In the observations upon the parasites of the tussock moth this species was by far the most abundant of the Chalcidids reared. It is parasitic upon *Pimpla inquisitor*, upon both of the species of Apanteles, upon both species of Meteorus, and probably also upon *Limneria valida* when affecting this host. It was first reared August 30, 1895, from one of the isolated cocoons of *Pimpla inquisitor*, and in the course of the ensuing year hundreds of specimens were reared. Nearly 400 were counted, but many more issued. The mere labor of counting the specimens on some days of abundant issuing from the mass of Orgyia cocoons placed in the breeding cages was too great to be undertaken. From August 30 to November 6 a number of specimens issued nearly every day. The most abundant periods of issuing were about the 1st of September, the last of October, and the 1st of November. None were reared during the winter of 1895–96, but they began issuing again from overwintered cocoons on March 31 and continued until the end of June, beginning again toward the end of July and issuing at intervals through the rest of the season. The number issuing from a single specimen of the host seems to depend entirely on the size of the host.

Although many host cocoons have been dissected, an instance has never been found where the host larva (and it is the larva apparently when full grown which is attacked) was not almost entirely destroyed, the only remaining fragment being the strip of shriveled skin. The only exception to this rule which the writer has noticed was in the case of an Apanteles cocoon which was examined December 31, 1896. In this cocoon was found a single pupa of the Dibrachys, while the perfectly developed Apanteles showed simply a large cavity at the base of the underside of the abdomen. The largest number observed to issue from a single cocoon of *Pimpla annulipes* has been twenty-three. In the instance in which this count was made the specimens emerging were counted, the cocoon was cut open and the number of pupal exuvia was found to correspond. Successful transformation had been effected in every case and the adults had all issued through two holes, one near one end of the Pimpla cocoon and the other near the other end. Pimpla cocoons were found, however, during the winter of 1896 in which there were as many as twelve exit holes of this parasite, while in another instance twenty-two specimens of the Dibrachys issued from a single hole in a Pimpla cocoon. This time, however, the hole was near the middle of the cocoon.

A number of cocoons of Apanteles were cut open December 13, 1896, and in one case contained two larvæ of this Dibrachys, which transformed to pupæ December 29. The pupæ were at first milk-white, and no darker color, even in the eyes, was observed. Thirty-six hours later the eyes had become red, and ten days from pupation (January 8, 1897) the adults emerged. From a single cocoon of *Meteorus communis* the highest number of this species reared was six.

Judging from the large number of specimens which issued at the end of October and first of November, and from the fact that the dissections of the Apanteles cocoons just referred to in December showed larvæ and pupæ, this insect seems to hibernate both as adult and as larva. The midwinter condition of this species in the cocoons of Pimpla is described in the closing paragraphs of the section on *Pimpla inquisitor*. It occurred both as larvæ and pupæ December 13 to 16, and adults issued in warm rooms December 27.

The larva and pupa, as well as the adult, are shown at fig. 18. The simple nature of the mouth parts of the larva is especially brought out. So far as can be ascertained, the maxillæ are not differentiated, nor is there any differentiation of the parts of the labium. The only parts observed are mandibles, labrum, and labium. The mandibles are very minute and are excessively sharp, looking like minute slightly curved spicules.

A singular and practically inexplicable instance was observed December 16, 1896, where in a cocoon of the Orgyia a dead female chrysalis was found in an advanced stage of development. The moth was apparently just ready to emerge at the time of death. All of the scales on

the body and legs were fully formed and the wings were also fully developed. On breaking the body across, in the interior of the abdomen were found two active living larvæ, which were entirely indistinguishable from the larva of this species. The specimen was put aside to await developments, and the writer has at this time no explanatory comments to make.[1]

This species has been observed to oviposit in freshly spun cocoons of Meteorus and of Amorphota. It has also been seen investigating cocoons of the Orgyia, presumably for the purpose of ascertaining whether they contained Pimpla cocoons. It oviposits customarily in parasite cocoons containing the as yet untransformed larva, although it may also lay its eggs in the parasitic larvæ which have just issued from the host and are about to begin spinning. We have no evidence that this species is often a tertiary parasite, but it is quite within the bounds of possibility that it may become so by virtue of ovipositing in cocoons of Meteorus, Apanteles, or Amorphota which have already been stung by *Spilochalcis debilis*.

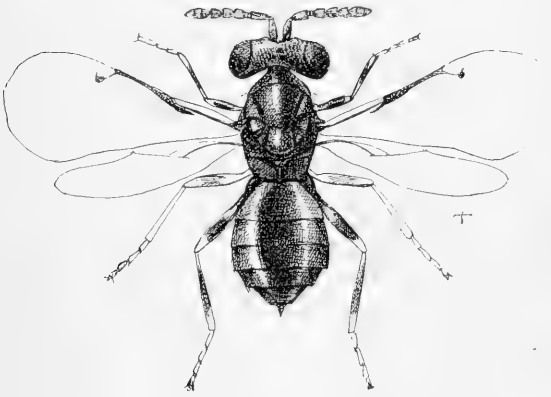

FIG. 19.—*Syntomosphyrum esurus*—greatly enlarged (original).

Syntomosphyrum esurus (Riley).

This interesting little hyperparasite was first reared from the cotton worm of the South (*Aletia argillacea*) in the course of the cotton-worm investigation by the U. S. Department of Agriculture in 1878. In Comstock's report on cotton insects, 1879, and in Bulletin No. 3 of the U. S. Entomological Commission, it was mentioned under the name *Cirrospilus esurus*. In the Fourth Report of the U. S. Entomological Commission it is designated as *Tetrastichus esurus*. The chrysalids of Aletia formed during the latter part of the season were frequently found infested with this parasite, each chrysalis nourishing a number. The parasite was found to be generally distributed and was reared in Texas, Alabama, and Georgia. Adults issued all through the autumn, during mild winter weather, and in the spring. It was considered in the first two reports published to be a primary parasite. In the fourth

[1]The only recorded instance of an at all similar case known to the writer was given by Rev. T. A. Marshall in the Entomologists' Monthly Magazine for December, 1896, in which an ichneumonid larva is said to have been found alive in the body of an adult *Acherontia atropos*. The writer's record (Proc. Entom. Soc. Wash., I, 95) of the rearing of *Ichneumon instabilis* by Scudder from an adult of *Œneis semidea* was based on a wrong reading of a manuscript note of Scudder's.

report the statement is made that it is possibly not a primary parasite, but that it infests one of the larger Ichneumonid parasites of the cotton worm. "This supposition is, however, contradicted by the fact that Aletia pupæ parasitized by this Chalcid are always found packed to overflowing with the Tetrastichus, whereas were the latter simply parasitic upon Pimpla or Chalcis they would in all probability be found only in the abdomen of the Aletia pupa."

In 1894 Mr. Ashmead (Trans. Am. Ent. Soc., Vol. XXI, pp. 343–344) described a parasite reared June 10, 1891, by Dr. A. D. Hopkins, at Morgantown, W. Va., from *Orgyia leucostigma* on maple, as *Syntomosphyrum orgyiæ*. This species proves to be identical with Riley's *S. esurus* and introduces it among the tussock-moth parasites. It has not been reared at Washington from the tussock moth, but during the spring of 1896 a large series of specimens was reared from overwintering chrysalids of the fall webworm. A single parasitized chrysalis was examined after these parasites had emerged and no trace could be found of a primary parasite. The exact host relations of this species must therefore still remain in doubt, although from group habits it is reasonably safe to say that it is a hyperparasite. In this event it may be secondary (feeding upon Pimpla) or tertiary (feeding upon Bathythrix).

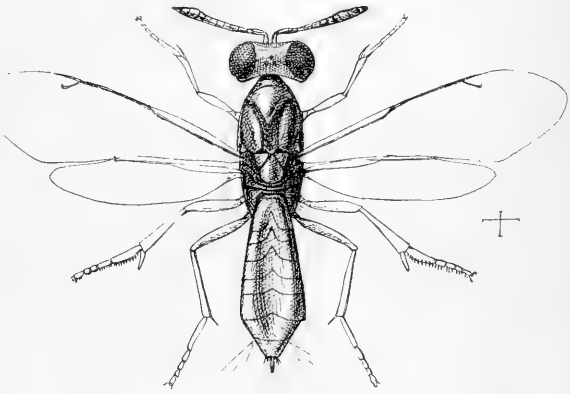

FIG. 20.—*Eupelmus limneriæ*: Female—enlarged (original).

Eupelmus limneriæ n. sp.[1]

But two specimens of this insect were reared in the course of the investigations upon the tussock moth, both issuing from cocoons of *Limneria valida*. It is the same species which was recorded in Bulletin No. 10 as being a hyperparasite upon Limneria and upon Meteorus.

Elachistus cacœciæ Howard.

This insect, which was originally described in Bulletin No. 5, first series, of the Division of Entomology, page 28, as probably a primary parasite upon *Cacœcia rosaceana* and *Hyphantria cunea*, now appears, without doubt, to be a secondary parasite. A single male issued in a vial in which the pupæ of what we take to be *Cratotechus orgyiæ* Fitch, shown at fig. 13, were being kept to rear the adult.

[1] Described in the appendix, page 56.

Elasmus atratus n. sp.[1]

The most abundant of the parasites of *Apanteles hyphantriæ* was, during the winter of 1896–97, this curious little Chalcidid, which was mentioned under its manuscript name in the writer's article entitled "The habits of Elasmus," Insect Life, Vol. IV, pages 253–254, as being a common parasite of *Apanteles hyphantriæ* in the District of Columbia. No specimen of this insect was reared in 1895 and none in 1896 until the end of December. December 13 a number of cocoons of the Apanteles were found in the cocoon mass of the Orgyia, and all were cut open, as described under the section on Apanteles, for the purpose of ascertaining the hibernating condition of the Apanteles. In nearly every cocoon thus examined were found from two to four small black pupæ, one of which is shown at fig. 21. These pupæ were at once seen to be

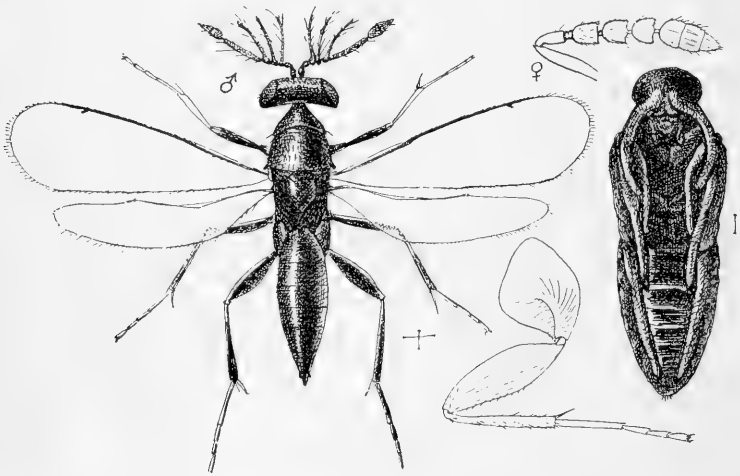

FIG. 21.—*Elasmus atratus:* Adult male at left, with hind leg and female antenna, and with pupa at right—enlarged (original).

different from the pupæ of Dibrachys, and were placed in a vial to rear the adults. The adults issued December 29 to January 15, 1897, and proved to be *Elasmus atratus*. The date of issuing is doubtless abnormal, since the specimens were purposely kept in a warm room to force early issuing in order to determine the species as soon as possible. Normally, they probably would not have issued until spring.

Asecodes albitarsis Ashmead.

This insect plays in the economy of the Orgyia the apparently unusual rôle of a tertiary parasite. Its immediate host is *Dibrachys bouchcanus*. We have secured the pupa of the Dibrachys under circumstances which render its identity positive, and it has been carefully illustrated at fig. 18*b*. The identity of this pupa having been ascertained, the actual

[1] Described in the appendix, page 56.

observation on the Asecodes issuing from the pupa shown at fig. 22, and through the round hole on the ventral side below the head at once establishes the tertiary parasitism. Very many specimens of this species were reared. The dates of rearing in numbers were September 10 to 12, November 6, 1895, January 20, April 29, and July 30, 1896. We have found neither the pupa nor the larva of this species. A strange variation in habit was observed September 9, 1895, and again in December, 1896, when a number of specimens of this species issued from one of the puparia of a little scavenger fly, *Gaurax anchora*.

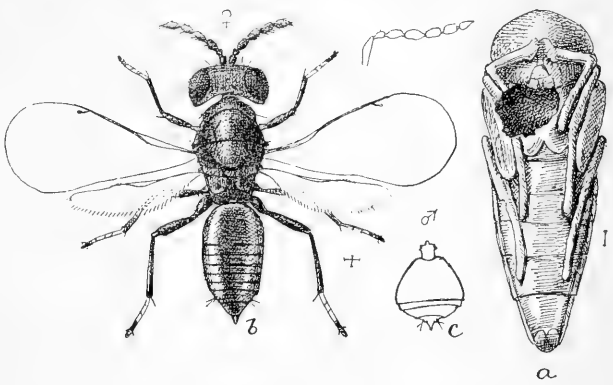

FIG. 22.—*Asecodes albitarsis: a*, pupa of Dibrachys from which this parasite has emerged; *b*, adult female; *c*, male abdomen—greatly enlarged (original).

With this species we have a possible though unproved instance of quarternary parasitism. In the closing paragraph of our consideration of the Dibrachys we have shown how it may become a tertiary parasite. In such an instance as this the Asecodes, should it be attracted to such a stung cocoon of Meteorus, for example, would become quarternary.

Frontina aletiæ Riley.

This is the first of the primary dipterous parasites to be discussed.[1] It is one of the most important enemies of the cotton caterpillar of the South, from which fact it derives its specific name. It was found in the course of the investigations of the cotton worm that this fly issues from puparia formed by maggots issuing from the larva and occasionally the pupa of *Aletia argillacea* in Georgia, Alabama, Mississippi, and Texas. It has been estimated at different times that the proportion of caterpillars killed by this species has reached 40 per cent. Its further distribution is stated by Mr. Coquillett to be Massachusetts, Florida, California, and Venezuela. It has been reared at this office from several different host insects. In addition to Aletia and Orgyia it has issued from *Cerura* sp., *Dasylopha anguina*, *Halisidota maculata*, *H. tessellata*, *Heterocampa manteo*, and *Lagoa opercularis*.

[1]The writer is fortunate in presenting these few notes in having the benefit of the assistance of Mr. D. W. Coquillett in the determination of the species and, further, the opportunity to consult the notes on habits and distribution which he has brought together for a monographic paper on the Tachinidæ of North America.

It was first met with in the course of the observations upon Orgyia on August 30, 1895. A larva of the Orgyia which had already spun up could plainly be seen to be parasitized. A large dipterous larva could actually be seen through its skin. No eggs, however, were found upon its body. It was placed in a vial to breed and on the following day two Tachinid larvæ left the empty and dry skin of the caterpillar and transformed to puparia, which, however, dried up and nothing was reared from them. On September 7 a tussock-moth caterpillar was found which bore Tachinid eggs upon its back, and from this larva an adult of this species issued on September 18. On September 20 an adult emerged from a puparium the larva of which issued from an Orgyia larva found September 5, and which was collected for the reason that it had a black spot around one of the spiracles; the larva issued on September 9 and transformed to its puparium, making the duration of the puparium stage eleven days. The same day a specimen issued from a tussock-moth caterpillar which was observed upon September 11 to have been oviposited in by *Pimpla inquisitor*. On September 6 an Orgyia cocoon was opened which contained a chrysalis upon which a dipterous larva was apparently feeding externally. This maggot contracted into a puparium, and a fly of this species issued on September 23. On September 13 a full-grown tussock-moth caterpillar was found which had a sick appearance and a pale-colored head. On September 18 a full-grown Tachinid larva issued from it and contracted, and the fly issued September 30. The total number of specimens of this insect reared was forty-five. They issued quite regularly through September; two specimens appeared in October, one in January, two in February, and the remainder between the 14th and 27th of July, 1896. During the examination of Orgyia cocoons in the winter of 1896 no specimens of this insect were found in any stages. In all probability it hibernates as an imago.

Frontina frenchii Will.

This species is very widespread, occurring from Massachusetts to California, and has been reared from no less than twenty-two different species of Lepidoptera, including Bombycids, Noctuids, and Rhopalocera (*Papilio turnus* and *Pyrameis cardui*).

In the Orgyia observations it was not an important species and was not reared at all in 1895. Seventeen specimens were reared, all in July, 1896. In the case of two of the specimens the flies issued July 6 from two puparia found June 29. There is nothing in the observations which indicates the duration of any of the different stages.

Tachina mella Walker.

This species is also widespread, occurring in Toronto, Canada; Franconia, N. H.; Massachusetts; New York; District of Columbia; West Virginia; Florida; Texas; New Mexico; California, and Oregon. It has

been reared from several different Bombycid larvæ at this office. It appeared both in 1895 and 1896 in the present series of observations. On September 16, 1895, a single adult issued from an Orgyia cocoon taken September 7. In the different series of rearings undertaken to ascertain percentage of parasitism eighteen specimens issued, five in September, 1895, and the remainder in July, 1896.

Euphorocera claripennis Macq.

This was the most abundant of the Dipterous parasites. Like the other species, it occurs practically all over the country. It has been reared at this office from twenty-seven distinct species of Lepidoptera, including among the species of greatest economic importance *Agrotis ypsilon*, *Aletia argillacea*, *Anarsia lineatella*, *Ceratomia catalpæ*, *Datana ministra*, *Feltia herilis*, *Hydræcia immanis*, *Hyphantria cunea*, *Leucania albilinea*, and *Mamestra trifolii*.

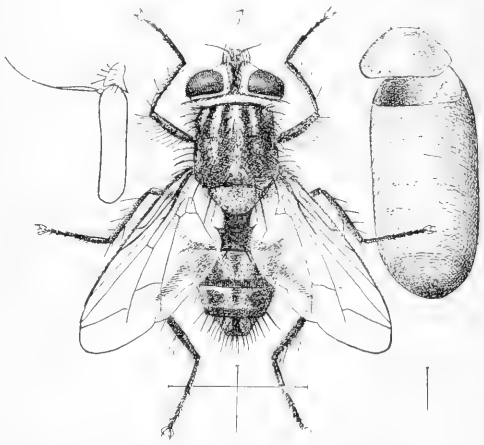

Fig. 23.—*Euphorocera claripennis:* Adult with enlarged antenna and with empty puparium at right—enlarged (original).

It was first reared on September 21, 1895, from a pupa of Orgyia collected September 7, the Tachinid larva having left the chrysalis before pupating. September 23 a specimen issued from a puparium found within a chrysalis of Orgyia on September 6. On September 24 one specimen issued from a larva found September 7 with a single Tachinid egg attached to it. Another issued on the same day from a larva found September 4 with a Tachinid egg attached to it, and still another from a larva found September 11, also with a Tachinid egg upon its back. This last had pupated within the body of its host. On the 30th of the same month a specimen issued from a caterpillar found in its cocoon September 11, and in which *Pimpla inquisitor* had been observed to oviposit.

Ninety-seven specimens in all were reared; eighty-one of them issued between September 19 and October 15, 1895, a single specimen issued April 16, and the remainder appeared from July 14 to 28, 1896. The usual method of hibernation here must also be in the imago state, although in the case of the fly which issued April 16 the puparium must have overwintered.

Winthemia quadripustulata Fabr.

This, again, is a species of wide distribution, occurring throughout the northern portion of the United States and also in Germany. It has been reared from twelve species of lepidopterous larvæ at this office, including certain cutworms, the army worm (*Leucania unipuncta*), the grass worm of the South (*Laphygma frugiperda*), the promethea caterpillar (*Attacus promethea*), and several sphingid larvæ. Four specimens were reared in the Orgyia observations, three issuing in late October, 1895, and the fourth April 14, 1896, this latter having evidently hibernated in the puparium.

Exorista griseomicans v. d. W.

This species, which we know only from the District of Columbia and Central America, and which has been reared from this host insect alone, made its appearance in our experiments only in late July, 1896, when four specimens were reared from the mass of Orgyia cocoons under observation.

THE SCAVENGER FLIES.

Helicobia helicis Towns.
Sarcophaga (two species).
Phora nigriceps Loew.
Phora incisuralis Loew.
Phora fasciata Fallen.
Phora agaraci Lintner.
Limosina sp.
Homalomyia scalaris Fab.
Gaurax anchora Loew.
Neoglaphyroptera bivittata Say.
Diplosis sp.

It seems hardly worth while to give any detailed consideration to any of the above species. All were reared from Orgyia cocoons, and most of them from cocoon clusters which had overwintered and were collected in the spring of 1896 and placed in rearing jars for observation. It was especially noticed that nearly all of the scavenger flies, particularly the Sarcophagids, after issuing, remained among the litter at the bottom of the cage, whereas the adults of the parasitic Diptera, and Hymenoptera as well, immediately flew to the upper parts and sides of the cage, apparently trying to find a way out.

By far the most abundant of the eleven species was the little Oscinid, *Gaurax anchora*. This little fly, shown at fig. 24, was first reared on September 10, 1895. Its larvæ and puparia were found abundantly in old Orgyia cocoons the larvæ of which had been destroyed by *Pimpla inquisitor*. The larvæ of the Gaurax were found to feed upon the quite dry remains of the caterpillar.[1] Other larvæ were found in dead pupæ early in September. Several hundred were reared in all, of

[1]Loew, Centur., VII, page 111, mentions the fact that Osten Sacken found the larvæ of this species in New York feeding gregariously upon the chrysalis of the Cecropia moth inclosed within its cocoon. In Osten Sacken's catalogue the fact is recorded simply in the words "inquilinous in cocoons of *Attacus cecropia*." The same species was reared from the cocoons of the gypsy moth (*Porthetria dispar*) by Professor Fernald and his assistants.

which only five appeared in the fall of 1895, the remainder appearing in May, July, and August, 1896. Active larvæ of this species were found feeding upon the remains in old cocoons in the middle of December, 1896, and remained rather active for several weeks in spite of cold weather.

Living puparia of one of the species of Sarcophaga were found in the old cocoon masses of the Orgyia in December, 1896, and nearly all of the specimens of both species issued in July and August, 1896. The other Sarcophagid, *Helicobia helicis* (Towns.), originally reared from a snail (*Helix thyroides* Say) by Mr. H. A. Surface, Warren County, Ohio, seems to be a general scavenger after all. Eighteen specimens were reared in October, 1895, from cocoon masses of the Orgyia, and three more July 27, 1896. It is a widespread species, and Mr. Coquillett

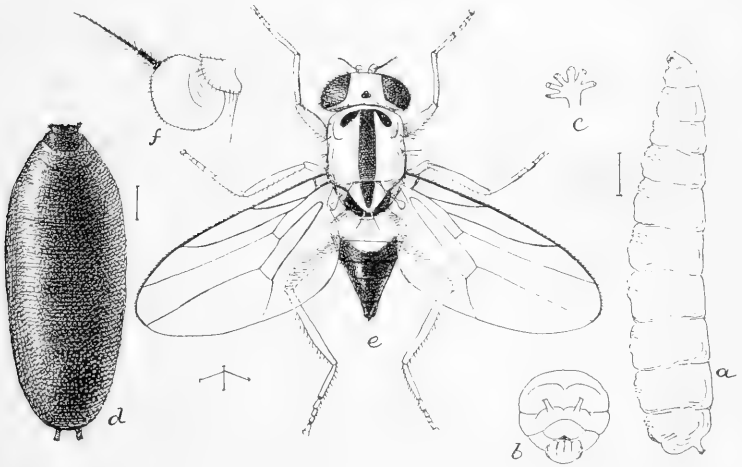

FIG. 24—*Gaurax anchora*: *a*, larva; *b*, anal segment of same; *c*, spiracles of same; *d*, puparium; *e*, adult; *f*, antenna of same—*a*, *d*, *e*, enlarged; *b*, *c*, *f*, still more enlarged (original).

has recorded it from Charlotte Harbor, Florida, Mississippi, Illinois, Los Angeles, Cal., Ohio, and the District of Columbia (Proc. Acad. Nat. Sci. Phil., 1895, p. 317).

The four species of Phora were not reared in large numbers. Of *P. nigriceps* about thirty were bred from dead larvæ of Orgyia at the end of July, 1896. Of *P. incisuralis* five specimens were reared September 1, 1896. Of *P. fasciata* eight were reared July 28 to 30, 1896, and of *P. agarici* one specimen was reared September 30, 1895, from discolored chrysalids of Orgyia collected September 13, while on October 28 of the same year about a dozen specimens were reared from another discolored chrysalis, also found on September 13. The facts gained by the rearing of these four species of this genus present no positive evidence on the question as to whether Phora may ever attack living insects.

Of the Limosina a single specimen was reared September 2, 1896,

while the only specimen of the Anthomyiid (*Homalomyia scalaris*)[1] which was reared was found in the breeding cage with cocoons of Orgyia on September 26, 1895. *Neoglaphyroptera bivittata*, a beautiful little black and yellow Mycetophilid, was reared in two instances, the first on May 28 and the second one April 30, 1896. They were found in the breeding cage with cocoons of the Orgyia collected October 15 of the previous year. The Diplosis was reared in April, 1896, and again in September, 1896, the first time from cocoons collected October 15, 1895, and the second time from cocoons collected in July, 1896.

THE OTHER INSECTS.

Among the other insects found feeding upon the tussock-moth caterpillars or reared from their cocoon masses none are worthy of especial mention with the exception, perhaps, of the larvæ of *Anthrenus varius*. These larvæ were found constantly in the old cocoon masses of the Orgyia and under the batches of eggs which had already hatched, where they were engaged in feeding upon the dry remains of pupæ and eggs. This is quite in accordance with the known habits of this insect. Its frequent occurrence in the egg masses led us to surmise that it might be found to feed upon the living eggs, and thus become a true enemy of the tussock moth. Predatory habits begin in this way. This surmise was proved to be correct in February, 1897. Mr. Busck, who had been instructed to watch carefully all egg masses which he should observe out of doors, with this object in view, brought in, February 14, two egg masses which had evidently been eaten by some insect. Both egg masses were eaten on one side of the surface. One was eaten into from the under side, and in the hole was a cast skin of the larva of a *Trogoderma*, presumably *T. tarsale*. These egg masses were carefully examined, since it was suggested that simply the frothy secretion might have been fed upon, but eggs were found which had been half eaten, and examination of the other eggs in the mass showed that they were unhatched and living. Later, on the same day, Mr. Busck was sent out for additional material, and succeeded in finding a spot where the egg masses were numerous and collected 50 or more larvæ of *Anthrenus varius* and *Trogoderma tarsale* hidden among the egg masses. These were brought in and kept under observation in confinement. It was soon proved beyond all doubt that they eat sound eggs of the tussock moth with avidity, and certainly just as readily as they eat dead animal matter, which was given them at the same time. We have thus the beginning of what may ultimately prove to be a very beneficial predatory habit on the part of these Dermestid larvæ. The only record known to us of a true predatory habit on the part of a Dermestid larva is published by A. Kuwert in the Stettiner Entomologische Zeitung for 1871, page 305, where it is stated that the larvæ of

[1]This species is common to Europe and North America. In Europe its larva has been found in human excrement.

Megatoma undata were found inside the cocoons of *Tenthredo lutea*. Kuwert considered their work in killing pupæ of this sawfly of considerable importance and ascribed the immunity of his garden from the work of the sawfly larvæ to this cause. It seems, however, that there may still be doubt about the accuracy of his conclusions.

As illustrating the necessity for the most careful examination of all the circumstances surrounding a case of supposed parasitism, and as bearing upon the subject of *Anthrenus varius*, the fact may be mentioned that on December 17 a living specimen of an adult Proctotrypid parasite was found in the center of an empty egg mass of the Orgyia. The species was new to the series of Orgyia parasites, and study showed it to be *Laelius trogodermatis* Ashmead, a parasite, as the name indicates, of Dermestid larvæ. Further examination showed a full-grown larva of the Anthrenus in the same egg mass. Mr. Ashmead informs the writer that he has previously reared this Proctotrypid from *Anthrenus varius*, and the presence of this specimen on the Orgyia egg mass was thus explained.

A very constant feature in the examination of the Orgyia cocoon masses during December, 1896, was the finding of many of the characteristic cocoons of a Chrysopa. They were hidden away among the mass in all conceivable situations. Some were empty, some contained parasites, while others contained the hibernating larvæ of the Chrysopa. During the preceding summer adult Chrysopas were reared in some numbers from Orgyia cocoon masses placed in the rearing cages for study. The frequent parasitism of these Chrysopa cocoons introduced another element of danger in drawing conclusions as to the true parasites or hyperparasites of Orgyia. For a time the writer considered one of the species of Hemiteles (*sens. lat.*) reared from the Orgyia cocoons as one of the tussock-moth hyperparasites. While opening many Orgyia cocoons, however, in December, one was found which contained several old and empty cocoons of *Pimpla inquisitor*, and in one of these, back at its far extremity, was the puparium of a Sarcophagid fly, from which the adult had issued. More in a spirit of idle curiosity than in anticipation of any result, this empty puparium was cut open and here again in its far extremity was another object, the cocoon of this Chrysopa. The cocoon was intact, and upon cutting it open it was found to contain an adult of the Hemiteles, which up to that time had been considered a hyperparasite of Orgyia. The larva of the Sarcophagid having reached full growth after feeding on the remains of the Pimpla pupa skins, or perhaps dead pupæ as well, had transformed within the Pimpla cocoon and the fly had issued. The parasitized full-grown Chrysopa larva, seeking to hide itself as effectually as possible, had crawled first into the Orgyia cocoon, second into the Pimpla cocoon, and third into the empty puparium, and in its far extremity, with its little remaining strength, had spun its own cocoon only to die immediately thereafter from the attacks of the larva

of a primary parasite already containing eggs of the hyperparasitic Hemiteles!

The abundance of these Chrysopa cocoons in these situations does not, it seems to us, prove that the larvæ which constructed them had fed upon the Orgyia. It is more likely that they were attracted by the abundance of dipterous larvæ, particularly of the larvæ of the little Gaurax, although this is supposition only.

The work of predatory Heteroptera was not especially marked, and in fact for some reason these insects do not seem to prey as extensively upon tussock-moth caterpillars as upon the fall webworm and other caterpillars. We have already called attention to the exemption from bird attack which this species possesses, and in fact the conspicuous coloration of the caterpillar seems to mark it as an especially protected form.

GENERAL CONSIDERATIONS.

Except for the remarkable number of species involved, there is nothing, perhaps, after all, so extremely unusual in the extensive case of parasitism of which we have just given the details. Wherever a plant-feeding species from some cause or from some combination of causes transcends its normal abundance to any great extent, there is always a great multiplication of its natural enemies, and this multiplication is usually so great as to reduce the species to a point even below its normal. Exceptions to this rule are seen with especially protected species, which, through the possession of some distasteful or repugnant quality, have no predatory or parasitic enemies. Even in such cases, however, disease steps in and fills the want. I need only refer to the chinch bug as a familiar example of this class of injurious insects. It possesses no parasites, but when it increases beyond the bounds of what may be called nature's law, for want of a better term, bacterial and fungous diseases speedily carry it off.

With all very injurious lepidopterous larvæ, however, we constantly see a great fluctuation in numbers, their parasites rapidly increasing immediately after the increase of the host species, overtaking it numerically and reducing it to the bottom of another ascending period of development. The unusual number of parasitic forms in the present case, however, and the extreme thoroughness of their work, as well as the plain evidence of the important part which hyperparasites have played, renders this particular case of perhaps more than usual interest.

The culmination of the Orgyia attack may be placed at the end of August and early part of September, 1895. At that time almost every poplar, soft maple, box elder, elm, alder, birch, and willow in the city of Washington was completely defoliated, while other maples, sycamores, horse-chestnuts, ashes, and many other trees were badly damaged. The rapidly developing parasites (some of them, as we have shown, requiring only two weeks for the development of an entire generation) by this time had become so numerous that it was an exception

to find a healthy caterpillar which one of the parasites was not engaged in stinging. The rearings which were undertaken at this time show a parasitism of perhaps 90 per cent of the caterpillars.

The species principally involved in this work were *Pimpla inquisitor* and *Chalcis orata*, both primary parasites. The remaining species were not abundant and very few hyperparasites were reared in the autumn of 1895. It is worthy of record, however, that many caterpillars were killed at this time by some disease the nature of which has not as yet been ascertained, although some work has been done upon it by Mr. A. F. Woods. About 10 per cent of the cocoons at the end of September gave forth adult moths, and of these, of course, only about one-half were females. Ten per cent, then, of the possible females of the fall generation laid their eggs, and the majority of these eggs hibernated successfully, so that in April and May, 1896, there was a moderately abundant hatching of young Orgyia caterpillars.

In the meantime, however, the extremely abundant primary parasites had successfully hibernated and were in position to make their presence felt. It resulted that at the points of observation this first generation of tussock-moth caterpillars was practically exterminated, and in June it was a very difficult matter to find enough living individuals to carry on rearing-cage experiments at the very points where they had been present the previous year by thousands and thousands. Rearing-cage experiments at this time showed the actual percentage of parasitism to reach above 98 per cent. The details of one of these experiments follows:

On June 30 and July 8, 1896, 624 cocoons of the tussock moth were collected without discrimination from the trunks of trees in the U. S. Department of Agriculture park. From these 624 cocoons issued the following parasites:

	Specimens.
Pimpla inquisitor	729
Bathythrix pimplæ	13
Limneria valida	1
Theronia fulvescens	1
Chalcis ovata	69
Dibrachys boucheanus	[1]50
Asecodes albitarsis	1
Frontina aletiæ	7
Frontina frenchii	14
Tachina mella	12
Euphorocera claripennis	15
Exorista griseomicans	4
Total	916

Thus from the 624 cocoons were reared 916 parasites, all but 64 of which were primary. Of moths 12 were reared, and with the exception of these 12, all of the others which were not parasitized, and these

[1] Estimated.

were only a few, died from disease. The exact mortality ratio was, therefore, 98.08 per cent.

In the later months of 1896 the abundant presence of hyperparasites was made manifest. Many hundreds of specimens of *Dibrachys boucheanus* were reared from the cocoons of the Pimpla, and while the next most important primary parasite, *Chalcis orata*, has not definitely been proved to have its own parasites, it is almost safe to state that it also is destroyed by this species or some other of the secondary parasites. The other primary parasites, notably *Meteorus communis*, *Limneria valida*, and the Apanteles, were also, almost without exception, destroyed by hyperparasites, principally *Spilochalcis debilis* and *Dibrachys boucheanus*.

The effect of this hyperparasitism began to be noticed by the time the third generation of tussock-moth caterpillars became full grown. It was no longer so difficult to find specimens as it had been in June. They were still rare, however, and the number of egg masses laid in the late autumn at the points where these studies were carried on was very small.

The length of time which it will take the Orgyia to recover from this exterminative parasitic attack can not be surmised. The partial recuperation toward the close of 1896 was a matter of some surprise, and must be attributed almost entirely to the work of hyperparasites. Ordinarily recovery from a severe case of parasitism following an undue multiplication of lepidopterous larvæ is rather slow, as is instanced by the published records regarding the army worm (*Leucania unipuncta*).

We should naturally have expected a period of abundance of tertiary parasites to have followed that of the secondary parasites. This, however, was not the case. Tertiary parasitism seemed to be comparatively rare and was only definitely proven in the case of *Asecodes albitarsis* and *Dibrachys boucheanus*, the latter being usually a secondary parasite. The majority of the specimens of the Asecodes issued in the late fall and early winter of 1895–96. There must be a limit to this work of parasite upon parasite at some point, and it seems certain that tertiary parasitism is rare, and that quaternary parasitism seldom occurs. An interesting fact was, however, noticed in the late fall and early winter of 1896, and that was that many of the parasitic larvæ died apparently as the result of disease, although possibly from some other cause—as, for example, the puncture of a hyperparasite, the larvæ of which did not develop. A number of dead larvæ of *Pimpla inquisitor* and *Dibrachys boucheanus* were found in the Orgyia cocoons in December, 1896, more or less shriveled and slightly moldy, but apparently whole.

It must be stated that nearly all of the observations which we have recorded were made on or in the immediate vicinity of the grounds of the U. S. Department of Agriculture, and that observations made incidentally and by no means with the same thoroughness in other parts of the city show that conditions vary in neighboring localities, and that

at different points, distant from each other less, perhaps, than a mile, there was by no means the same relative abundance of species. It can be seen at the time of this writing (January, 1897) that hibernating egg masses of the Orgyia are certainly four times as abundant at some places in the city as they are at others, a fact which points plainly to a greater scarcity of primary parasites at the first-named points. The tussock-moth caterpillar is itself a slow traveler. Its primary parasites naturally congregate at the points of greatest caterpillar abundance. At points where the caterpillars are scarcer they are thus less exposed to the attacks of their parasitic enemies, and it results that there may actually be an increase of the species at one point simultaneously with a decrease at another. This, then, at once suggests that in a small way artificial transportation of the Pimpla in particular may often be of some practical benefit.[1]

The part played by the dipterous parasites in this instance was not great. Only 187 specimens in all were reared. All were of rather well-known Tachina flies, which are general and widespread parasites. Even though the work of these species was not important in this instance, as is well known, they frequently play a most important part in the reduction of the numbers of injurious larvæ.[2]

It is an extraordinary thing that these flies are by no means so restricted in their host relations as are the parasites which belong to the order Hymenoptera. The parallelism between structure and host relation, which is so striking among the Hymenoptera, seems to be practically absent with these parasitic Diptera, as Brauer's tables plainly indicate.

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[1] It has been shown, for example, that *Pimpla inquisitor*, the most numerous of the parasites mentioned, is a very general feeder on lepidopterous larvæ, and in such cases as this extensive parasitism of Orgyia in Washington, if the right moment were seized, a surplus of the parasites could readily be sent to such points as Boston, for example, where the tussock moth appears to be abundant nearly every year, and where, perhaps, the species would be found to attack even the gypsy moth, although, according to the reports of the gypsy moth committee, this species has not as yet been reared from this host.

[2] The writer has searched for hours in grass fields overrun with army worms without finding a single specimen of the worm which did not bear upon its back the eggs of *Winthemia 4-pustulata*. It has long been known that many of these eggs fail to produce any result, through the molting of the caterpillar before the hatching maggots have an opportunity to work their way into its body, but the observations made by Professor Fernald and his assistants in their work upon the gypsy moth in Massachusetts have thrown a new light on the number of failures in Tachina parasitism. On page 385 of the 1896 report upon the gypsy moth it is stated that during the summer of 1893 Mr. Reid collected a number of caterpillars on which the eggs of the parasites had been laid. Two hundred and thirty-five of these caterpillars, having from 1 to 33 eggs on each, were fed in cages until they changed to pupæ, and from these 226 moths emerged, but only 4 dipterous parasites were secured from the entire number. The caterpillar which had 33 Tachina eggs on it molted before the eggs hatched, passed through all its transformations, and the moth emerged in good condition. In 1895, 50 larvæ bearing eggs were isolated, and 43 moths resulted and no parasites. Later 252 caterpillars were taken in the field, each bearing dipterous eggs, and were fed and carried through their transformations without the appearance of a single adult Tachina fly.

The main function of the Diptera in the interesting struggle which we have described was that of scavengers. The scavenger flies were much more abundant than the parasitic flies, and the dead bodies of the caterpillars, the chrysalis skins, and the remains of the different species of parasites were abundantly preyed upon by species of this class.

The table which follows shows the exact host relations of the Hymenoptera reared in the course of the observations:

Table showing host relations of the Hymenopterous parasites so far as they are known or surmised.

[Host, Orgyia leucostigma.]

Primary parasite.	Secondary parasite.	Tertiary parasite.	Possible quaternary.
Pimpla inquisitor	Dibrachys boucheanus	Asecodes albitarsis	
	Allocota thyridopterigis	Habrocytus thyr.?	
	Bathythrix pimplæ	Dibrachys boucheanus	
	Adiastola americana		
Pimpla annulipes			
Pimpla conquisitor	Allocota thyridopterigis	Habrocytus thyr.?	
Ichneumon cœruleus			
Ichneumon subcyaneus			
Amorphota orgyiæ	Spilochalcis debilis	Dibrachys boucheanus?	Asecodes albitarsis?
	Dibrachys boucheanus	Asecodes albitarsis	
Meteorus communis	Spilochalcis debilis		
	Otacustes periliti		
	Bathythrix meteori		
	Dibrachys boucheanus		
Meteorus hyphantriæ	Spilochalcis debilis	Eupelmus limneriæ	
	Otacustes periliti		
	Dibrachys boucheanus		
Limneria sp			
Limneria valida	Dibrachys boucheanus	Tetrastichus sp.?	
	Eupelmus limneriæ		
	Elasmus atratus		
Theronia fulvescens			
Apanteles hyphantriæ	Spilochalcis debilis	Dibrachys bouch.?	Asecodes albitarsis?
	Dibrachys boucheanus	Asecodes albitarsis?	
	Elasmus atratus		
Apanteles delicatus	Spilochalcis debilis		
	Dibrachys boucheanus		
	Elasmus atratus		
Chalcis ovata			
Pteromalus cuproideus			
Cratotechus orgyiæ	Elachistus cacœciæ		
	Tetrastichus sp.?		
Telenomus orgyiæ			

As far as we were able to ascertain, the dipterous parasites had no hyperparasites. It will be seen that there were seventeen species of primary Hymenoptera and six of primary Diptera. Of the secondary hymenopterous parasites there were thirteen species, several of them, however, affecting more than one species of primary parasite. There were but two species of tertiary parasite, so far as positive observations go, but three other species were strongly suspected to sustain this relation, while, as indicated, one of the species of which we have proof of tertiary parasitism may under certain conditions, in our opinion, prove to be a quaternary parasite. In the table those species followed by an interrogation point are problematically placed. The parasitism indicated is strongly suspected, but has not been definitely proved. The placing of all of the other species is based upon exact observations.

APPENDIX.—DESCRIPTIONS OF NEW SPECIES.

Genus AMORPHOTA.

Amorphota Foerster. Verh. d. Naturhist. Ver. d. Preus. Rheinl. u. Westph. 1868, p. 151.

Amorphota orgyiæ new species.

Female.—Length 9.5 mm; expanse 11 mm. Color black; abdomen rufous, with darker petiole; disk of second segment and hind border of same black; all legs rufous, except hind tibiæ and tarsi, which are black; trochanters, tarsi, and spurs of hind tibiæ light yellow, nearly white; antennal scape rufous; mouth parts and tegulæ whitish; head and thorax densely and finely punctate, with sparse whitish pubescence, more marked on metanotum; metanotum with shallow central longitudinal groove with transverse elevations; abdominal segments 3 to 6 subequal in length; 7 shorter; 2 longer; the latter two-thirds length of petiole.

Male.—Resembles female, except that abdomen is darker, dusky shade extending down its dorsum; femora are of darker rufous; scape black.

Described from two females, one male, reared from *Orgyia leucostigma*.

Habitat: District of Columbia.

U. S. National Museum type No. 3509.

Genus BATHYTHRIX.

Bathythrix Foerster. Verh. d. Naturhist. Ver. d. Preus. Rheinl. u. Westph. 1868, p 176.

Bathythrix meteori new species.

Female.—Length 7 mm.; expanse 11 mm. General color black and rufous; head, mesoscutum, mesopleura and metathorax black; all legs, including coxæ, abdomen, prothorax, mesoscutellum, tegulæ, rufous; abdomen darker toward tip; front and middle coxæ and trochanters, all tibiæ and tarsi lighter; sheaths of the ovipositor black; antennæ rufous with the joints accentuated with black; darker toward tip; mandibles dark rufous; palpi white; head and mesoscutum finely shagreened; mesopleura nearly smooth, shining; metanotum with several distinct raised areolets; entire thorax with fine white pile, more abundant upon metanotum and at borders of clypeus; abdomen shining, faintly longitudinally aciculate-punctate; abdominal segments decreasing in length from 1 to 7.

Male.—Resembles female except that abdomen is black at tip; antennæ fuscous; thorax shining and very faintly shagreened.

Described from many male and female specimens reared from cocoons of Meteorus.

Habitat: District of Columbia.

U. S. National Museum type No. 3511.

Bathythrix pimplæ new species.

Female.—Length 6.5 mm; expanse 11 mm. General color black; head and thorax opaque; abdomen shining; all legs, including coxæ, rufous, with the exception of black band at the tip of hind femora and at tip of hind tibiæ; hind tarsi blackish, except at base of first joint; mandibles dark rufous; palpi nearly white; mesothorax very faintly and sparsely punctate; metascutum divided into six areolets; entire thorax with sparse fine whitish pile; lower face with very close and dense whitish pile, particularly marked at edge of clypeus.

Described from three female specimens, presumably parasitic upon *Pimpla inquisitor*.

Habitat: District of Columbia.

U. S. National Museum type No. 3512.

Genus **ADIASTOLA**.

Adiastola Foerster. Verh. d. Naturhist. Ver. d. Preus. Rheinl. u. Westph. 1868, p. 180.

Adiastola americana new species.

Female.—Length 5 mm.; expanse 9 mm. General color black; all coxæ and femora and joints 2 to 7 of abdomen rufous; hind tibiæ and all tarsi black; front and middle tibiæ rufous; tegulæ whitish; mandibles and palpi black; petiole black, finely longitudinally aciculate; ovipositor sheaths nearly black; head and mesonotum very finely and very closely granulate, subopaque; mesoscutellum shining; areolets of metascutum marked, the hinder median one very concave, showing on profile view two sharp prominences; pleura shining, but very delicately shagreened.

Male.—Resembles female except that abdomen is entirely black and that second abdominal segment, as well as petiole, is closely longitudinally aciculate, though not so coarsely as petiole.

Described from two females and one male reared from cocoon masses of *Orgyia leucostigma* and presumably parasitic upon *Pimpla inquisitor*.

Habitat: District of Columbia.

U. S. National Museum type No. 3510.

Genus **PEZOMACHUS**.

Pezomachus Gravenhorst. Ichneumon. Europæa, II, 1829, p. 867.

Pezomachus insolitus new species.

Male.—Length 5 mm.; expanse 10 mm. General color black; antennæ dusky; all legs, including coxæ, dark rufous; under side of abdomen, especially at base, somewhat rufous; clypeus rufous; mandibles rufous, black at tip; palpi dusky, nearly black; tegulæ dark; fore wings yel-

lowish at base; head and mesonotum shining, very faintly shagreened; metanotum closely punctulate with areolets faintly indicated; abdomen shining, very faintly shagreened; joints 4 and 7 subequal in length; 1 to 4 gradually decreasing in length; stigma pitchy black, yellowish at proximal extremity.

Described from three males reared from cocoon masses of *Orgyia leucostigma*.

Habitat: District of Columbia.

U. S. National Museum type No. 3513.

Genus APANTELES.

Apanteles Foerster. Verh. d. Naturhist. Ver. d. Preus. Rheinl. u. Westph. 1862, p. 245.

Apanteles delicatus new species.

Male.—Length 2.8 mm.; expanse 6.2 mm. General color black; all legs, except coxæ, light reddish-yellow, hind tibiæ somewhat darker at the tips; palpi light honey-yellow; face faintly punctate, with a slight incomplete median carina below insertion of antennæ; clypeus regularly rounded; metascutum with faint median longitudinal carina; abdomen rather coarsely punctate on first three joints; remaining joints smooth; joints 1 and 2 with slight median carina, which is absent in joint 3; dorsal plate of first segment with somewhat rounded sides; pleura faintly shagreened.

Described from two males reared from *Orgyia leucostigma*.

Habitat: District of Columbia.

U. S. National Museum type No. 3514.

Genus PTEROMALUS.

Pteromalus Swederus. Vetensk. Acad. Handl., 1795, T. 16.

Pteromalus cuproideus new species.

Female.—Length 3.5 mm.; expanse 6 mm. General color brownish-green; antennal scape rufous; funicle dusky; all legs except coxæ light honey-yellow; tegulæ darker honey-yellow; abdomen and metathorax concolorous with remainder of thorax and head, except that the basal two-thirds of second abdominal segment is blue or purplish, the second segment occupying a little more than one-third of the dorsal extent of the abdomen; joint 3 as long as 4 and 5 united; 6 and 7 subequal, longer than 3, the terminal segment conical; head and thorax uniformly and rather coarsely punctate; metascutum with median longitudinal carina and two curved lateral carina.

Male.—Differs from female in possessing yellowish antennæ with scape black at extreme base; color somewhat brassy.

Described from one male and one female reared from *Orgyia leucostigma*.

Habitat: District of Columbia.

U. S. National Museum type No. 3515.

Comes closest to Ashmead's *P. acronyctæ*.

Genus EUPELMUS.

Eupelmus Swederus. Vetensk. Acad. Handl., 1820, pp. 136, 376.

Eupelmus limneriæ new species.

Female.—Length 3 mm.; expanse 4.2 mm. General color dark metallic green; all coxæ metallic green; front femora honey-yellow, with dark, somewhat metallic stripe on outer side; middle femora honey-yellow, somewhat darker above; hind femora metallic; front and middle tibiæ honey-yellow; hind tibiæ with rather more than basal half fuscous; tibiæ yellowish white; all tarsi yellowish, black at tip; antennæ black, somewhat metallic; body moderately stout; abdomen about as long as thorax, widening gradually to joint 5; joint 6 rather abruptly acuminate; head about as wide as thorax; mesoscutum sparsely punctate; mesoscutellum and mesopleura closely and finely shagreened.

Male.—Differs in having all femora honey-yellow; hind tibiæ dusky; middle tibiæ dusky toward tips; punctation of mesoscutellum similar to that of mesoscutum.

Described from one male and one female reared from cocoons of *Limneria valida*.

Habitat: District of Columbia.

U. S. National Museum type No. 3516.

Genus ELASMUS.

Elasmus Westwood. Lond. Edinb. Phil. Mag., III, 1833, p. 43.

Elasmus atratus new species.

Female.—Length 1.6 mm.; expanse 3.2 mm.; greatest width of fore wing 4.6 mm. Face and vertex with moderately sparse large punctures; pronotum and mesoscutum regularly scaly, with sparse hairs; mesoscutellum very finely shagreened, shining; abdomen smooth, rather longer than head and thorax together; pleura and hind coxæ shining, the latter finely aciculate; antennæ very short; funicle joints subequal in length and about as long as wide; club slightly flattened; hind tibiæ above with three closed cells of spines placed end to end and a portion of another cell at each extremity; general color black, shining; thorax with faint metallic cluster; meso-postscutellum not differentiated in color; front and middle tibiæ dusky, rather lighter at bases.

Male.—Antennal branches dusky, reaching to base of club; in other respects resembles female.

Described from many male and female specimens reared from *Apanteles hyphantriæ*, *Apanteles delicatus*, and *Limneria valida*.

Habitat: District of Columbia.

U. S. National Museum type No. 3517.

APPENDED NOTE.

Prof. V. Deprez has given, under the title "Une Invasion de Dasychira pudibunda," in the Annales de la Société Entomologique de Belgique for 1895, pages 333–335, some account of an outbreak of a European species closely related to our white-marked tussock moth in the vicinity of Carlsbourg, in the years 1892 to 1895.

Vigorous efforts were made by the authorities to put a stop to the work of the insect. The forestry administration employed a special oil, made in Germany, to cover the eggs and thus to asphyxiate them, and also made use of different methods for preventing the climbing of the trees by the caterpillars. Moreover, the inhabitants of the surrounding villages were requisitioned in May to collect the perfect insects. "Nevertheless," says Professor Deprez, "what can human means accomplish against such a prodigious quantity of enemies?" "Happily," he says, "nature, always foresighted, has placed a remedy beside the evil, and the researches of the most eminent naturalists have established the law that when an injurious insect develops in abnormal numbers its parasites are but little behind it in becoming proportionally multiplied. Thus, with the species of which we are speaking we have noticed an increasing multiplication of its natural enemies—the Ichneumon flies—which charge themselves with the duty of reducing considerably the number of the caterpillars, and often of reestablishing the equilibrium which had been broken for several years."

Experiments were instituted to determine the increase of the parasites. In the winter of 1892–93, among 200 chrysalids, 30 were found to have been parasitized. A year later, from the same number, 53 were parasitized. A year later, in the winter of 1894–95, from the same number, 95 were found to be parasitized.

How far this instance falls, in the completeness of the parasitism, below the instance which we have described in the foregoing pages will at once be evident. His concluding paragraph, freely translated, reads: "Will this proportion of the parasites increase still further during following years, as has been noticed in other countries, so as to bring about the complete stoppage of this unusual outbreak of the caterpillars, or will the parasites themselves be destroyed by other parasites, which, limiting their destructive action, will thus prolong the caterpillar invasion? Future observations will determine."

11859—No. 5——5

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EXPLANATORY TO THE TECHNICAL SERIES.

While the work of the Division of Entomology is entirely carried on with the practical end in view, a certain amount of work of a technical character is constantly being done by different members of the force. The condition of our knowledge of North American insects at the present time is such that many forms which from time to time spring into prominence as destructive species, or as connected with destructive species, either as parasites or predatory enemies, are found to be new to science. They must be classified, described, and given names before they can be intelligently considered in economic publications. The practice which has prevailed to a limited extent of naming and describing new species in practical bulletins and reports is one which has met with much disfavor among systematic workers. Isolated descriptions of new species are in themselves sources of great annoyance to all workers, and when these isolated descriptions are published elsewhere than in scientific journals or the proceedings of scientific societies the annoyance becomes intensified. The force of the Division of Entomology comprises several specialists who are doing descriptive work, and largely upon material accumulated in the course of the regular divisional work. They are doing this work as a necessary supplement to the purely economic output of the Division, and to facilitate the investigations of the entomologists of the State Agricultural Experiment Stations. It becomes important that the results of their labors should be published promptly, and as all available sources of publication in this country, such as the Proceedings of the United States National Museum and the Transactions of the American Entomological Society, are chronically overcrowded with manuscripts, and are not published with any degree of promptitude, it is necessary that they should be issued by this Department.

L. O. H.

Technical Series No. 6.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

THE SAN JOSE SCALE

AND ITS NEAREST ALLIES.

A BRIEF CONSIDERATION OF THE CHARACTERS WHICH DISTINGUISH THESE CLOSELY RELATED INJURIOUS SCALE INSECTS.

Prepared under the direction of the Entomologist

BY

T. D. A. COCKERELL,

Entomologist of the New Mexico Agricultural Experiment Station, Las Cruces, New Mexico.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1897.

DIVISION OF ENTOMOLOGY

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., April 26, 1897.

SIR: I have the honor to submit for publication the accompanying technical bulletin, which it is hoped will enable all entomologists as well as all other persons who have access to a compound microscope to distinguish definitely between the San Jose scale and its closest allies. This bulletin has been prepared under your authorization by Prof. T. D. A. Cockerell, whose long technical study of the scale insects has especially fitted him for the work. Although the specific characters of the San Jose scale have been given in a number of different publications, they have not been displayed by exact contrast to those of the most closely allied species, and it has resulted that almost all of the entomologists in the United States have felt themselves unable to decide authoritatively as to the identity of suspected forms, and have always forwarded specimens either to this office or Professor Cockerell in New Mexico for certain determination. It is the hope and expectation of the author of the bulletin and of the writer that by the aid of this account of the insect and its allies all of this uncertainty will be done away with and that much valuable time will be saved.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

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THE SAN JOSE SCALE AND ITS NEAREST ALLIES.

By T. D. A. Cockerell.

THE PRELIMINARY EXAMINATION.

Suppose that some objects suspected to be San Jose scales have been found upon a fruit tree. The first thing to do is to ascertain whether they are scales (Coccidæ) at all. I have known fly marks to be taken for Coccidæ, and occasionally the lenticels on the young growth of trees are supposed to be scale insects by those whose experience ought to have taught them better. It is really remarkable how the lenticels on cottonwood twigs in the Mesilla Valley, N. Mex., resemble a scale prevalent in that locality, *Aspidiotus juglans-regiæ* var. *albus*. From a short distance the deception would be complete but for the fact that the lenticels are arranged at approximately equal distances from one another and not massed like scale insects. Still more like coccids are certain fungi; I have on occasion been obliged to use a lens to ascertain which I had before me. At Mesilla, N. Mex., I found on the dead wood of an apple tree a fungus which closely resembled the second stage, or immature male scales of the San Jose scale. This fungus was kindly identified for me by Mr. J. B. Ellis as the cytispora stage of *Valsa ambiens* Persoon. It is presumed that no entomologist will be misled for more than a moment by lenticels or fungi, but for those who are not entomologists it may be recommended to scrape the object with the finger nail or a knife blade, when, if it is a scale insect, it will readily come away, leaving at most only a pale film.

Granting now that we certainly have a scale insect before us, it is to be learned whether it belongs to the subfamily Diaspinæ. A mealybug has no scale—only some mealy or cottony secretion; a *Lecanium* or shield scale is itself the scale—that is, the insect becomes hardened and scale like, but has no scale separable from its body. But the Diaspinæ are small soft insects, in the adult ♀ stage without legs and unable to move, which secrete a scale separate from themselves, much like the shell of an oyster. With a lens it is easy to make out the insect and its scale, the latter having first been overturned with the point of a knife. The scale, it is further seen, carries the exuviæ of the two first stages, or only one if it be a male.

Now, then, if we are sure that we have a Diaspine is it an *Aspidiotus*—the genus of the San Jose scale? In *Aspidiotus* the female scales are round, or nearly so, and the male scales vary from round to oval, according to the species, but are always of a similar texture to those of the female. Therefore we shall not be misled by *Mytilaspis*, in which

the female scales are elongate, pointed at one end; nor by *Chionaspis*, which have the female scales more or less pyriform in outline, and the male scales linear, soft, white, with the usually yellow larval skin at one end; nor by *Diaspis*, which has the female scale much like *Aspidiotus*, but the male scale like *Chionaspis*.

FIG. 1.—*Diaspis piricola:* characters of female (original).

We may be misled by *Diaspis* if, as sometimes happens, we find only female scales. In Europe two similar species, one an *Aspidiotus* (*A. ostreæformis*), the other a *Diaspis*, were long confounded under one name. The *Aspidiotus piricola* recently described by Del Guercio, which I have recognized in specimens found on *Prunus* in California, is said by Berlese to be in reality the *Diaspis* just mentioned (see fig. 1). I formerly saw only female scales, but have lately received those of the male, which are as in *Diaspis*. A figure is given so that the insect may be recognized by those who come across it.[1]

THE STUDY OF THE SCALE.

With an ordinary pocket lens the characters of the scale can be made out. The following table may be found useful:

A. Scale quite convex, about 1½mm. diameter, whitish with an ochreous or grayish tint, with a contrasting *dark* spot marking the exuviæ, which are toward the side.

1. Scale somewhat translucent, so that it has a decided orange or yellowish tinge when covering the living insect; a species not extending above the lower austral zone.....*A. rapax* Comst.
2. Scale more opaque, thus appearing whiter; a species common in the upper austral zone, found mainly on poplars and willows.....*A. convexus* Comst.

---

[1]Attention is called to the four rudimentary lobes on each side, besides the large median ones, which are dark-colored. There is a well-marked median or anterior group of ventral glands, numbering at least eight. As Mr. A. C. F. Morgan remarked, in *Aspidiotus ostreæformis* the inner lateral margins of the median lobes are produced to encircle the anus, while there is nothing of the kind in the *Diaspis*. There has been some question as to what name this *Diaspis* should bear. Fitch's *Aspidiotus circularis* (Tr. N. Y. Agr. Soc., 1856) from stalks of currant at Albany, N. Y., has been thought referable to it, and would be the oldest name; but it doubtless belongs to *A. ancylus*, which Dr. Lintner has found on black currant in Albany. I do not recommend its use for *ancylus*, however, as it is an unrecognizable *nomen seminudum*, so far as Fitch's publication goes. The names *pyri* and *ostreæformis*, as applied to the *Diaspis* by Boisduval and Signoret, respectively, can have no claim, being merely misidentifications of Linnean and Curtisian species. We are thus obliged to fall back on Del Guercio's specific name, and call the insect *Diaspis piricola* (Del Guerc.); unless it can be proved identical with *D. pyri* Colvée, Ann. Soc. Ent. France, Bull., 1881, p. lii. The difficulty with regard to Colvée's insect arises from his account of the grouped ventral glands; he gives, caudolaterals 18 to 20, cephalolaterals 20 to 24, median *never more than six*, sometimes less or even none. In the *Diaspis* the median group is larger, while the others are smaller, viz, median 8 to 12, caudolaterals 8 to 14, cephalolaterals 12 to 13.

B. Scale flattened, but comparatively large, diameter 3mm., or nearly; exuviæ forming a slight prominence between the middle and the side, when rubbed so as to remove a thin film of secretion, appearing shining orange or foxy-red.
   1. Scale grayish-brown ..... *A. juglans-regiæ* Comst.
   2. Scale white ..... *A. juglans-regiæ* v. *albus* Ckll.

C. Scale flattened like the last, but smaller; diameter 2mm. or less.
   1. Scale pale grayish, with a slight reddish tinge, the male scales suffused with blackish, exuviæ of the ♀ scale somewhat to the side of the center, dull orange ..... *A. howardi* Ckll.
   2. Scale blackish or dark gray to dull black, the exuviæ when exposed a deep orange-red, their position somewhat away from the center.
      a. Scale usually very dark, first skin hardly raised or nipple-like; a species common in the transition zone, often on maples ..... *A. ancylus* Putn.
      b. Scale somewhat paler, first skin somewhat raised and nipple-like, with faint indications of a dot and ring ..... *A. forbesi* Johns.
   3. Scale of female gray, with the exuviæ central, or nearly so, yellowish, ♂ scales showing a distinct dot surrounded by a ring, which is not the case in *A. howardi*.
      a. ♂ scale all black, the dot and ring not distinguished by color, but distinctly sculptured; a Japanese species ..... *A. andromelas* Ckll. n. sp.
      b. ♂ scale grayish, hardly black, with a light dot and ring. *A. perniciosus* Comst. (San José scale).
      c. ♂ scale grayish black, the light dot and ring very conspicuous; occurs on orange and plum in Japan ..... *A. perniciosus* v. *albopunctatus* Ckll.

The scale of *A. cydoniæ* Comst., found on quince in Florida, resembles that of *rapax*. *A. crawii* Ckll. n. sp., a Mexican species, has also a convex scale, but the exuviæ are not dark. The European *A. ostreæformis* Curt. has a black scale with deep orange exuviæ, and could easily be taken for *ancylus*.

It has been a matter for dispute whether the San Jose scale can be certainly recognized in the field. Its effect on the tree, killing the branches, is characteristic, but hardly in any true sense diagnostic; while the reddening of the tissues of the plant adjacent to the scale is sometimes well marked with *A. ancylus* as well as with *perniciosus*. A little experience, however, enables one to recognize the ashy-gray, generally thickly massed scales of *perniciosus*, with the dot and ring of the male scale; as against the dark scale and contrasting reddish-orange exuviæ of *ancylus*, or the similar scales of *ostreæformis* and *forbesi*. Nor will the very pale scale of *howardi*, found singly on plums, be likely to cause confusion. At the same time it is to be recommended that the diagnosis made in the field be in every case confirmed by examination of the insect under the compound microscope, if either locality or plant is new.

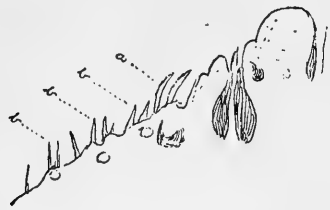
A. forbesi was only recently described from Illinois, but I have this year found it on apple trees in Mesilla, N. Mex., and it will probably be detected in other parts of America if looked for.

THE MICROSCOPICAL CHARACTERS OF THE ADULT FEMALE.

The female insect should be carefully removed from beneath the scale and boiled for a moment in strong liquor potassæ. It will then be transparent, and can be examined with a compound microscope. It

is the hind extremity of the insect which presents the characteristic features. I do not know whether it is the same with other people, but the writer can always judge best of the form of the parts when the tail is pointing upward, as in the accompanying figures. This is explained by the fact that the eye is more accustomed to judge of convexities (e. g., mountain ranges, tree tops, &c.) than concavities.

Having prepared the specimen, an examination shows various caudal structures, known as lobes, plates, and spines. The lobes are more or less rounded projections from the margin, of which there is a well-developed pair (the median lobes) at the caudal extremity, and varying numbers of outer ones, according to the species. The plates, so called, are gland hairs, and form a delicate fringe adjacent to the lobes; they are often branched. The spines are fine bristles, placed at intervals on the margin, projecting more nearly at right angles than the plates.



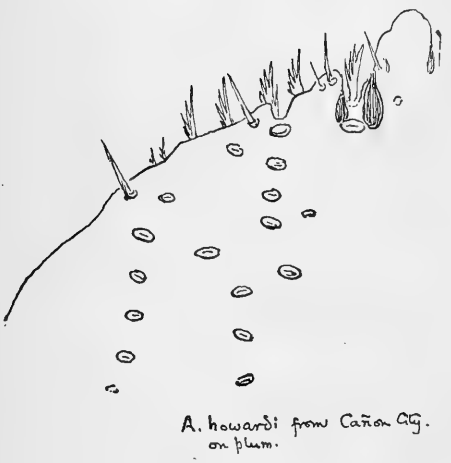


FIG. 2.—*Aspidiotus perniciosus* and *A. howardi*: characters of female (original).

Scattered over the surface of the hind part of the insect will be found oval glands, the position and number of which is often of importance. In connection with the glands at the bases of the lobes are found chitinous processes, which remain dark after boiling the insect in caustic potash, and are represented as dark fusiform objects in the figures.

The oval glands just mentioned are on the dorsal surface; but by changing the focus there will come into view, when present four or five groups of circular glands on the ventral surface, arranged about the genital opening. When well developed, these ventral grouped glands consist of an anterior or median group and two groups on each side, known as caudolateral and cephalolateral. Their function has long been doubtful, but Mr. E. E. Green (Ent. Mo. Mag., April, 1896, pp. 85–86) has hit upon what is almost certainly their true purpose, namely, to secrete the waxy powder which dusts the surface of the eggs. In accordance with this view, we find them to be very numerous in those forms which produce numerous eggs; less numerous in those which produce a few eggs at a time, which rapidly hatch; and wanting in

those which are ovoviviparous, and give forth their young in an active state. They are also wanting in the immature females and the males. The San Jose scale is viviparous, and wholly lacks these ventral glands, while they are present in the adult females of the allied *Aspidiotus forbesi*, *ancylus*, *ostreæformis*, *juglans-regiæ*, &c. They are wanting in *A. rapax*, which however will not be confounded with *perniciosus*, having a strongly convex scale, with dark sublateral exuviæ. If the grouped ventral glands are found, it may be assumed at once that the insect is not the San Jose scale; but it does not always happen that we have adult females under examination, so their absence, even though the scale be flattish, may not be conclusive. A little study of the

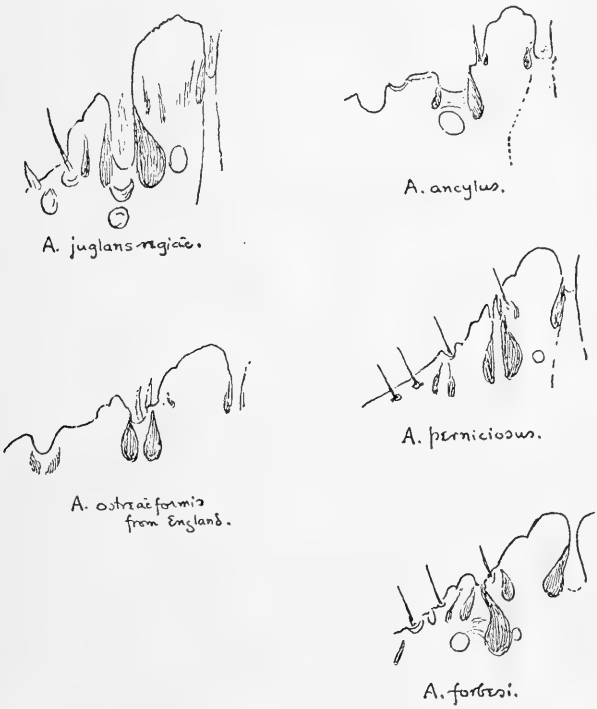


FIG. 3.—*Aspidiotus juglans-regiæ*, *A. ancylus*, *A. ostreæformis*, *A. perniciosus*, and *A. forbesi* (original).

accompanying figures will, it is hoped, remove all difficulty. It will be seen that in the true San Jose scale (*A. perniciosus*) the median lobes are large, upright, notched on the outer margin, though a little variable in form, as the different figures indicate. The second lobes are small but *distinct*, *quite close to the first*, variable in shape but inclined to be pointed, and notched also on the outer margin. The chitinous processes at the interval between the first and second lobes are *well developed*, *close together*, *and of nearly equal size*. Fig. 2 is designed to show the glandular hairs or "plates;" attention should be called to the fact that they are spine-like, at most feebly serrate, not branched; there is a large pair at *a* and three smaller pairs are shown at *b*. While the

small pairs of plates are quite characteristic, there is a fair amount of variation in these organs, and it is worth noting that if the specimens are boiled too long they are apt to be destroyed or detached.

In *A. ancylus* (fig. 3), the species most commonly confounded with *perniciosus*, it is seen that the shape of the median lobes is different, though these organs vary somewhat, and that *there is nothing but the merest rudiment of a second lobe.* It is further seen that the interval between the median lobe and the rudiment of the second is *very wide*, and that the chitinous processes are *far apart* and not of equal size, the innermost being the largest. There is also a gland orifice just below the interval. The plates of *ancylus*, not shown in the figure, are fringed and of the type shown in *howardi*, though less developed.

A. howardi (fig. 2) is of the type of *ancylus*, but the rudiment of the second lobe is somewhat more developed. The figure, from one of the type specimens, sufficiently indicates the characters and includes the oval dorsal glands. It must be admitted that *howardi* is very close to *ancylus;* perhaps only a variety of it.

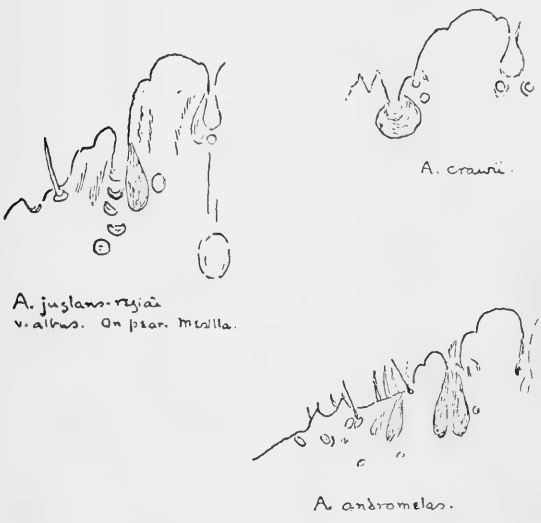


FIG. 4.—*Aspidiotus juglans-regiæ* var. *albus*, *A. crawii*, and *A. andromelas* (original).

A. forbesi (fig. 3) is really a good deal nearer to *perniciosus* than is *ancylus*. It will be noted, however, that the median lobes are more or less *oblique*, and especially that the chitinous processes of the interval between the first and second lobes are *very unequal*, the inner being *very large and curved*, the outer *very small*. The second lobe is quite distinct; Mr. Johnson figures it as entire, but it is almost always deeply notched.

A. ostreæformis (fig. 3), which has been found at Alameda, Cal., has the first and second lobes quite wide apart; but the second lobe, though small, is distinct. The form of the median lobes is somewhat peculiar.

A. juglans-regiæ (fig. 3) and its var. *albus* (fig. 4) ought not to be confounded with *perniciosus* on account of large scale, but figures are given in case of any difficulty. The difference in the shape of the median lobes shown in the two figures is not a constant one, as between the type and variety. This species will be further known by the very well-developed rows of oval dorsal glands, which are extremely conspicuous in mounted specimens.

A. albopunctatus, now regarded as a variety of *perniciosus* and *A. andromelas* (fig. 4), both Japanese, do not differ from *perniciosus* by any marked structural characters; *andromelas* is easily recognized by its scale.

A. obscurus, which Mr. G. McCarthy reports as occurring rarely on peach in North Carolina (N. C. Exp. Sta., Bull. 138), belongs to a different section of the genus from the above, and is distinguished at once by the dark gray scale, with exuviæ appearing pitch-black when rubbed. There are five groups of ventral glands, the median of as many as six.

The figure of *A. crawii* (fig. 4) illustrates the group of *rapax*, *convexus*, *cydoniæ*, etc. (subg. *Hemiberlesia* Ckll.), in which the median lobes are large but the others practically obsolete, or at best very minute. The plates are branched and crowded up toward the median lobes, making quite a dense fringe.

The following table of the grouped ventral glands may be found useful:

	Median.	Cephalo-laterals.	Caudo-laterals.
A. perniciosus	None.	None.	None.
A. andromelas	None.	None.	None.
A. rapax	None.	None.	None.
A. juglans-regiæ	0 to 4	7 to 16	4 to 8
A. forbesi	1 to 3	3 to 7	3 to 5
A. ostreæformis (from England)	6	11	9
A. convexus	None.	7	4
A. ancylus	0 to 6	6 to 14	5 to 8
A. cydoniæ	None.	8 to 9	5 to 7
A. crawii	None.	5	4
A. uvæ (on grapevine)	0 to 2	4 to 9	3 to 8
A. obscurus	6	12	8
A. howardi	None.	6 to 7	3 to 4
A. patavinus (on cherry in Italy)	0 to 2	4 to 9	7 to 10

THE SUBGENERA AND SECTIONS OF ASPIDIOTUS.

Professor Comstock, in his second Cornell report (1883), gave a table of the American species of *Aspidiotus* known at that time. It ran somewhat as follows:

A. Last segment of female with six groups of ventral glands. This includes *A. sabalis*, which is now placed in the genus *Comstockiella*.

AA. Last segment of female with less than six groups of ventral glands.

B. Last segment of female with three pairs of well-developed lobes, and with elongated thickenings of the body wall terminating at or near the bases of the lobes. This is the subgenus *Chrysomphalus* Ashmead (type *A. ficus*), with the related groups *Melanaspis* n. subg. (type *A. obscurus*), *Mycetaspis* n. subg. (type *A. personatus*), and *Aonidiella* Berl. & Leon. (type *A. aurantii*).

BB. Second and third pairs of lobes smaller or wanting; caudal margin with two pairs of incisions, with thickened edges. This includes the subg. *Diaspidiotus* Berl. & Leon., with the related group *Hemiberlesia* (type *A. rapax*).

BBB. With neither elongated thickenings of the body wall nor incisions with thickened edges. This includes subg. *Aspidiotus* s. str. (type *A. nerii*); Comstock also placed here *A. parlatorioides*, which belongs to *Pseudoparlatoria*. A figure is given of a Mexican specimen of this, showing some of the details more precisely than that of Comstock. It will be seen that it differs widely from any *Aspidiotus* in the characters of the female as well as those of the scale. Another species of this genus, *P. ostreata*, is very destructive to *Acalypha* in Jamaica.

A. nerii Bouché must be regarded as the type. It will be observed that the scale is light colored and the exuviæ are not covered by secretion. The terminal lobes of the female are wide apart, and the plates (or glandular hairs) are well developed and strongly fringed. There are no deep depressions between the lobes, and the chitinous processes at their bases are absent. The dorsal glands are very well developed (see fig. 6, *A. putearius*) and in form and position differ from those of other sections of *Aspidiotus*.

FIG. 5.—*Pseudoparlatoria paratorioides* (original).

It will be noticed at the outset that in the fringe, and especially in the dorsal glands, there is indicated some relationship to those remarkable genera, *Parlatoria*, *Syngenaspis*, and *Leucaspis*. These three genera are exclusively natives of the Old World, the recent determination of *Parlatoria pergandii* from China and Japan (specimens quarantined by Mr. Craw) showing that the one apparently American species, if regarded as valid, is of foreign origin. This tolerably obvious affinity would of itself indicate that *Aspidiotus* s. str. belonged to the Old World; and a careful survey of the genus reveals the fact that there is no good reason for supposing that any species of this subgenus is a native of America. *A. destructor*, so common in the West Indies, is unquestionably a native of the eastern tropics, whence it was originally described. *A. abietis*, a modified form of this subgenus, might be thought surely native of America, being found in New York and Georgia, but it proves to be a well-known species of Central Europe; and against the probability of its being a native of both continents is the fact that it does not occur in the coniferous forests of the West, as does the really native *Chionaspis pinifolii*. It can not be doubted, I think, that *A. abietis* (incl. *pini*) is an introduction from Europe.

FIG. 6.—*Aspidiotus putearius* (original).

There are two peculiar West Indian species which represent a modified type of *Aspidiotus* s. str., viz: *A. sacchari* and *A. hartii*. The

former occurs on sugar cane, the latter on yams, and I have not the least doubt that they were both introduced from the tropics of the Old World, though they have not yet been detected there. In certain features, and strikingly in the peculiar light purplish-brown tint of the scale, they are recalled by the Ceylonese *A. trilobitiformis*, which, however, departs more than they do from typical *Aspidiotus*. I am inclined to suppose that these resemblances indicate some real affinity.

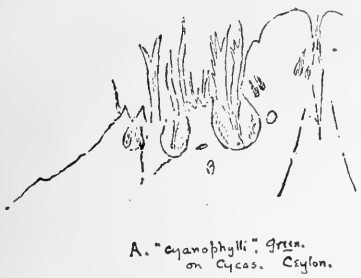


FIG. 7.—*Aspidiotus cyanophylli* of Green (original).

We therefore dismiss *Aspidiotus* s. str. as not American. In the Old World it is quite abundant; especially, it would seem, in the warmer parts of the temperate zone. Just how many species are known can not be stated, since several of those described are more or less questionable, either as to their validity or their position. There would seem to be about a dozen in Europe.

DIASPIDIOTUS (Berl. and Leon.) Ckll.

This subgenus was founded by Berlese and Leonardi for a mixture of species belonging to different groups. No type is designated, but *A. ancylus* is included, and may be taken as the type. This is the group in which the scale is usually dark-colored; the exuviæ are covered; the median lobes of the female are usually quite close together and much larger than the others, and there are between the lobes "incisions, with thickened edges." This is a circumpolar subgenus of the north temperate zone, living mostly on deciduous trees. Its food-plants and range coincide to a great extent with the subgenus *Eulecanium* of *Lecanium*.

FIG. 8.—*Aspidiotus trilobitiformis* (original).

In America this subgenus has several known species, and no doubt several await discovery. As we enter the tropics it almost disappears, or is replaced by the modified type *Hemiberlesia;* but in the West Indian region are two convex species which must be referred to *Diaspidiotus*—*A. punicæ* and *A. diffinis*. It is unfortunate that we know so little of the coccidæ of the south temperate zone of the New World, but in Chile is found at least one native *Aspidiotus*, *A. latastei*, which must be regarded as a much modified *Diaspidiotus*.

It is of interest to ask how far south *Diaspidiotus* goes in the Eastern Hemisphere. Mr. Green sends me a species found on *Cycas* in Ceylon, which he calls *A. cyanophylli*. But Signoret's *cyanophylli* belongs to *Aspidiotus* s. str., or at any rate is very close thereto, while Mr. Green's Ceylon species is a modified type of *Diaspidiotus*, largely comparable to the neotropical *Hemiberlesia*. I give a figure of the Ceylonese so-called *cyanophylli* (fig. 7) It may be named *A. greenii*.

Attention must also be directed to certain types which seem intermediate, more or less, between *Aspidiotus* s. str. and *Diaspidiotus*, while at the same time they recall *Chrysomphalus*. Such are *A. trilobitiformis* from Ceylon (fig. 8) and an apparently new species from England, which Mr. Newstead has taken for *A. hederæ* (fig. 9). No one could take *trilobitiformis* for a *Diaspidiotus*, but the so-called *hederæ* looks more like one at first sight. It may be said that as *Aspidiotus* s. str. is to *Parlatoria*, etc., so is *Diaspidiotus* to *Mytilaspis* and *Chionaspis*. The parallel is not exact, but it is approximate.

Fig. 9.—*Aspidiotus "hederæ"* (after Newstead).

Hemiberlesia Ckll.

This name replaces the preoccupied *Aspidites* Berl. and Leon., but with a very different significance. The type is *A. rapax;* and *perniciosus*, *tenebricosus*, *smilacis*, and *minimus*, referred to *Aspidites* by Berlese and Leonardi, all belong elsewhere—the first to *Diaspidiotus*, the next two to *Chrysomphalus*, and the last to *Aspidiotus* s. str. This subgenus really represents a southern modification of *Diaspidiotus*, with a convex scale and large median lobes, the others being suppressed. It appears to be exclusively American, and belongs to the tropical and lower austral regions, except that one species (*A. convexus*) occurs the upper Sonoran, and another (*A. ulmi*) in the corresponding zone in Illinois.

Chrysomphalus Ashm.

This subgenus must be credited to Ashmead, as at the time of publication Riley expressly disclaimed responsibility, though he had written the name first in his MSS. The first definition was given by Berlese and Leonardi; the type is *A. ficus*. In this subgenus the characters of the female are somewhat as in *Aspidiotus* s. str., but the chitinous

processes or tubular glands at the bases of the lobes recall the thickenings of a similar nature in *Diaspidiotus*, though they are much more developed, and are not accompanied by incisions. The scales are usually large, dark, and have covered exuviæ.

The distribution of *Chrysomphalus* is quite remarkable. It seems to be quite at home in the neotropical region, but, very curiously, it sends northward a branch along our Atlantic coast, even to Washington (*A. tenebricosus*) and Massachusetts (*A. smilacis*). These northern forms lack the groups of ventral glands, and so are presumably viviparous. In the Old World it is significant enough that it appears in several very well-marked forms in Australia, but in Asia and beyond it seems to be lost, or greatly altered. It appears probable that in such types as *trilobitiformis* and the so called *hederæ*, above alluded to, we see how it arose from *Aspidiotus* s. str., probably in the oriental or Australian region; while at the same time we have an indistinct hint of the manner of origin of *Diaspidiotus* to the northward.

From the point of view of geographical distribution, however, the striking thing is that while *Diaspidiotus* evidently reached America from the north, *Chrysomphalus* almost as evidently reached it from the south, and so may be taken as supporting the view that there formerly existed more land in the South Pacific Ocean. Had it been otherwise it seems incredible that there should be no native *Chrysomphalus* in Europe (unless the so-called *hederæ* be placed there) or on our Pacific slope.

It is to be observed that the male scale in *A. ficus* is almost round, a character which separates it at once from the similar *A. biformis*. In the Australian *A. cladii* the ♂ scale is considerably elongated.

MELANASPIS n. subg.

Type *A. obscurus*. This is a modified *Chrysomphalus* of American origin, with the exuviæ black and the female with five distinct groups of ventral glands. Berlese placed it in *Diaspidiotus*, to which it is not related. The Mexican *A. nigropunctatus* also belongs here.

MYCETASPIS n. subg.

Type *A. personatus*. This appears to be a greatly modified *Chrysomphalus*. The small convex scale is very peculiar, as also are the characters of the ♀. Although this is a common West Indian insect, it is just possible that it had its origin somewhere in the Old World. Mr. Green's *A. artocarpi* from India, by the small very convex scale, the white scar with a black ring it leaves when removed, and some other characters, seems to be allied to *personatus*.

AONIDIELLA Berl. & Leon.

Type *A. aurantii*. This shows a decided affinity with *Chrysomphalus*, but yet is very distinct in some of its characters. Its place of origin is uncertain, but I incline to the opinion that it represents a northward extension of *Chrysomphalus* in the Chinese region.

TARGIONIA Sign.

Type *A. signoreti.* This seems to be a modification of *Aspidiotus* s. str., but I have never seen specimens.

ODONASPIS Leon.

Type *A. secretus.* A peculiar oriental type, of uncertain affinities.

PSEUDAONIDIA n. subg.

Type *A. duplex.* Includes also *A. theæ* and *A. trilobitiformis.* A remarkable Asiatic type. The "lattice-work" patch of the ♀ is shared by the genus *Ischnaspis.*

CRYPTOPHYLLASPIS n. subg.

Type *A. occultus.* A form discovered by Green in Ceylon, living in leaf-galls on *Grewia.*

SELENASPIDUS n. subg.

Type *A. articulatus.* Common in the West Indies, but very likely of African origin. Its similarity to *Aonidiella* is but superficial.

XEROPHILASPIS n. subg.

Type *A. prosopidis.* An extraordinary little form found in Arizona; superficially it recalls *Mycetaspis.*

There are some other subgenera indicated by species which I have not seen, or have but partially examined. The above need not now be discussed in detail; it will suffice to separate them out, so as to leave the larger groups fairly homogeneous.

THE RELATIONSHIPS OF THE SAN JOSE SCALE.

Having now cleared the way by the separation of the subgenera, we can more intelligently discuss the position of the San Jose scale, *A. perniciosus*, in the system. Berlese and Leonardi placed it in *Aspidites*, but it is, nevertheless, a *Diaspidiotus*, as that subgenus is now defined.

On comparing it with the other species of the subgenus, we arrive at some interesting conclusions. It is now to be shown, for the first time, that *A. perniciosus* is, with little or no doubt, a native of Japan. For it is in Japan that there occur two varieties or subspecies of *perniciosus: andromelas* and *albopunctatus.* These agree almost exactly in structural features with *perniciosus*, but the first differs markedly in the color of the scale; the second slightly in the scale, and more noticeably (from an economic point of view) in attacking *Citrus.* Mr. Alex. Craw, however, says (in litt., Feb. 11, 1897): "The only time that I have found *A. perniciosus* on imported stock was from Japan on some apple trees, the grafts of which were purchased in America." Mr. Craw has examined great quantities of fruit trees from Japan, so it must be admitted that his experience carries weight. But there are various Japanese scales which Mr. Craw has found only once, and several found by Mr. Takahashi on cultivated plants in Japan have not yet

come into Mr. Craw's hands. It is only quite lately that Mr. Craw came upon *andromelas*. Further, if Japan is the native country of the San Jose scale, it is to be expected that it has there various natural enemies which keep it in check; it is not to be expected that it is found everywhere in quantities, any more than our native Diaspinæ are with us. Indeed, next time an economic entomologist goes to Japan he should make it his particular business to look up *A. perniciosus*, and see if there do not exist such natural enemies as are suggested, and whether, perhaps, one or more of them can be introduced into this country. It has been shown that *Diaspidiotus* enters the neotropical region, and this might be thought to favor the supposed Chilian origin of *A. perniciosus*. But even in the West Indies the type becomes largely modified as to the scale (*A. punicæ*, *A. diffinis*), and greater still is the divergence of the Chilian *A. latastei*—all this not at all in the direction of *perniciosus*. While it is true that certain of our nearctic types do appear in a striking fashion in the southern parts of South America, I should be greatly surprised to receive from thence such a scale as *A. perniciosus*.

FIG. 10.—*Aspidiotus betulæ* and *A. spurcatus* (original).

Still less can the supposed Australian origin be supported, as none of the native Australian species seem to belong to the same subgenus. Whether Maskell's "*Aonidia*" *fusca* is introduced *Asp. perniciosus*, it is difficult to say, but it would seem probable from what he has written on the subject. I am quite convinced, however, that the supposed variety of *perniciosus* recorded by Maskell as on *Eucalyptus* in Australia is not that insect; the description reads more like *A. forbesi*, but it is very likely something else.

It would seem that our native U. S. species of *Diaspidiotus* are not so very nearly related to those of Europe. An examination of such European types as *ostreæformis* (fig. 3), *betulæ* (fig. 10), *spurcatus* (fig. 10), etc., shows a group not to be well matched in this country, noticeable for its broad, low, median lobes. The difference, indeed, is not very great—not so great as between some of our own species—but yet it is sufficiently obvious. In our species the median lobes are narrower, and usually more inclined to be notched on the outer margin. Thus they seem nearer to the Japanese type of *perniciosus*, etc.

Of the American species, *A. forbesi* seems most to resemble *perniciosus* in the form of the lobes, etc., as will be evident from the figures. This insect is so far known only from several points in Illinois, and Mesilla, N. Mex. It is just possible that it also reached this country from Japan, since it was only described last year; but there is at present no good evidence in favor of such a supposition.

There is a tendency noticeable in our American *Diaspidiotus* to throw off a group with pallid, usually flatter scales, which occur on the peripheral parts of trees, the leaves, and even the fruit. Thus, from the type of *A. ancylus* we get *A. howardi*. I have lately received from the Division of Entomology a specimen of *howardi* (fig. 11) out of the original Canyon City lot, apparently more adult, and certainly better developed, than those Prof. Gillette, the collector, sent to me. In the figure the great development of the second lobe will be noted, so well is it developed as to suggest a different species on comparison with fig. 2, but I have found similar differences in the second lobe in *coloratus* (even from the same tree) and *uvæ*. In all of the species the second lobe seems to vary more or less. The well-developed second lobe of *howardi* has led to its being confounded with *comstocki*. This latter insect, occurring on the leaves of maples, is very much like *howardi* in many respects, but is curious for the median and second lobes having their tips on the same level (fig. 11), or the median lobes even being exceeded by the second. This character is found also in the tropical *A. destructor*, which, however, is an *Aspidiotus* s. str. The figure of *comstocki* given is from a specimen on sugar maple, Champaign, Ill.

FIG. 11.—*Aspidiotus howardi* and *A. comstocki* (original).

A. juglans-regiæ is certainly a very distinct form, its scales almost suggesting a *Chrysomphalus*. It seems to have been described from Europe as *juglandis*, but I believe it is a native of America, more especially since it has a marked color variety (*albus*) found in New Mexico.

HABITS OF THE SPECIES.

It may be said that *A. perniciosus* mainly affects rosaceous trees and shrubs. It is quite bad upon garden roses. Fearing that some of the published records might not be reliable, I asked Dr. Howard for a list of the food plants on which the scale had actually been seen at the

Division of Entomology. Here is the list as given: Apple, crab apple, quince, pear, Bartlett pear, dwarf Duchesse pear, plum, Japan plum, Satsuma plum, *Prunus pissardi*, *Prunus maritima*, peach, apricot, almond, cherry, Rocky Mountain dwarf cherry, currant, black currant, *Citrus trifoliata* (this should have been *albopunctatus*), Osage orange, grape, elm, cottonwood, European linden, American chestnut, *Pyrus japonica*, *Catalpa bignonioides*, walnut, Japan walnut, loquat, red dogwood, juneberry, rose, sumac, *Photinia glauca* (does this refer to *andromelas?*), Carolina poplar.

Thus the habitat on rosaceous plants is confirmed. As to the exceptions, too much stress should not be laid upon them, unless, perchance, some indicate the beginning of a new race, such as *albopunctatus*. I do not find the scale to infest the Osage orange nor the grape vines in the Mesilla Valley, even when they are grown abundantly in the vicinity of scaly orchards.

So far as we know, *A. forbesi* has similar food habits, but *A. ancylus* is different. This last is especially a maple species, and will flourish also on *Populus*, *Quercus*, etc.; it does not seem to take very kindly to fruit trees as a general rule. *A. ancylus* also does well (probably best) in the transition zone, whereas *A. perniciosus* belongs to the upper Austral.

As to the time of hatching, I have not statistics for the various species. At Las Cruces, N. Mex., I found *A. perniciosus* to begin producing young as early as April 26. A somewhat later date is given for other localities.

The manner of attack is different, more or less, in the various species under discussion. *A. ancylus*, on fruit trees, will be found upon the smaller branches, but in my experience more or less scattered, rarely in any great quantity. *A. perniciosus* is found largely upon the branches, becoming very abundant, covering and killing them. On the young shoots the reddening effect is very marked, though *ancylus* will also produce reddening. *A. forbesi*, as seen on apple trees in Mesilla, occurs largely under loose bark on the trunk, wintering there in numbers, and only invades the branches in limited quantity. Thus, there may be quite a lot of *forbesi* on a tree without its being noticed. *A. juglansregiæ* occurs on the trunk and twigs, more or less scattered, or in little groups.

ANNOTATED LIST OF THE SPECIES OF ASPIDIOTUS.

ASPIDIOTUS Bouché.

Palæarctic.

A. (*Aspidiotus s. str.*) **abietis** Schr.—♀ scale dark gray, margin lighter, exuviæ covered. ♀ with three pairs of lobes, plates divided at ends, ventral grouped glands present. ♂ orange, with the thoracic band very dark. Europe and N. Y. *A. pini* Comst. is the same species.

A. (*Aspidiotus s. str.*) **affinis** Targ.—♀ scale circular, with central exuviæ; 6 lobes; scale-like plates; grouped glands present. On *Ruscus aculeatus*. Italy.

A. (*Diaspidiotus*) **betulæ** Baer.—♀ scale plumbeous, with an orange spot indicating the place of the covered exuviæ. The scale is much like that of *A. ancylus*. On bark of birch in Europe. Said to occur in New Jersey.

A. (*Aspidiotus s. str.?*) **caldesii** Targ.—♀ scale thin, circular, pellucid, white; exuviæ central; median lobes very large; grouped glands wanting. ♂ scale elliptical. On *Daphne*.

A. (*Aspidiotus s. str.*) **ceratoniæ** Sign.—Allied to *nerii*, but differs in the ♂, which has the thoracic band almost invisible, etc. On *Ceratonia* at Nice.

A. (*Aspidiotus s. str.*) **ericæ** Boisd.—Resembles *nerii*. On *Erica mediterranea* in France. (Nomen seminudum.)

A. (*Aspidiotus s. str.*) **denticulatus** Targ.—♀ scale thin, transparent; grouped glands wanting. On *Rubia peregrina*. Italy.

A. (*Aspidiotus s. str.*) **genistæ** Westw.—On *Genista*. Similar to *A. nerii*. (Nomen seminudum.)

A. (*Aspidiotus s. str.*) **gnidii** Sign.—On *Daphne gnidium*. Similar to *A. nerii*. (Nomen seminudum.)

A. (*Aspidiotus s. str.*) **hederæ** Vall.—♀ scale yellowish-brown, exuviæ central and yellow. ♀ with 6 lobes. On ivy, holly, and box.

A. (*Diaspidiotus*) **hippocastani** Sign.—♀ scale circular, blackish, exuviæ central and yellow. ♀ with the median lobes large; grouped glands present. On horse-chestnut.

A. (*Diaspidiotus?*) **ilicis** Sign.—♀ scale grayish-yellow, exuviæ nearly marginal; grouped glands four in number. On *Quercus ilex*. France. (Essai, 1869, p. 123.)

A. (*Diaspidiotus*) **juglandis** Colv.—♀ scale small, reddish, almost always isolated; i. e., not massed. ♀ with two pairs of lobes, the median ones much the largest; four groups of ventral glands, cephalolaterals 8 to 12, caudolaterals 6 to 9; a single orifice marking the median group. The rows of dorsal glands, four in number, are very well marked; the first of 3 or 4, the second of 7 or 8, the third of 22 to 24, and the fourth of 16 to 18. Found in Catalonia, NE. Spain. I think this is the same as *A. juglans-regiæ;* both were published in 1881. I do not know which has priority. This is not *A. juglandis* Fitch, 1856, which is *Mytilaspis pomorum*.

A. (*Aspidiotus s. str.*) **lentisci** Sign.—♀ scale yellowish-brown; allied to *nerii*. S. France and Algeria.

A. (*Aspidiotus s. str.*) **minimus** Leon.—♀ scale suboval. ♀ yellow, very large median lobes, a smaller second pair, no groups of ventral glands. The small ♀ scales, less than a mm. diam., are found on the leaves of *Quercus ilex*. Portici, Italy. (Riv. Pat. Veget., IV, 350.)

A. (*Diaspidiotus*) **niger** Sign.—♀ scale circular, black, exuviæ yellow; two lobes; no grouped glands. On willow. France. (Essai, 1869, p. 130.)

A. (*Aspidiotus s. str.*) **oleæ** Colv.—On the olive in Spain, producing yellow spots on the fruit at the points attacked. Through the kindness of Dr. Howard I have been able to see the "Gaceta Agricola del Ministerio de Fomento," Vol. XIV, No. 2 (1880), containing Colvée's description. The insect is said to most resemble *A. nerii, ceratoniæ*, and *villosus*, and we are told how these three differ from it, without any direct statement of its specific characters. It seems to be nearest to *nerii*, differing only in the ♂. It is worth while to remark that in the same paper there is described a *Diaspis oleæ* Colv., which has escaped the notice of coccidologists. This may not be a *Diaspis*, as the ♀ scale has a black spot in the middle marking the exuviæ, and ♂ scale is dirty gray. The ♀ itself is of an intense mulberry color.

A. (*Subg. ?*) **oleastri** Colv.—Description not seen. Described in "Nuevos Estudios sobre algunos insectos de la familia de los Coccidos." (Valencia, 1882.)

A. (*Diaspidiotus*) **ostreæformis** Curt.—♀ scale, similar to that of *A. ancylus*. ♀ with four lobes, the median pair much the largest. Western Europe. *A. pyri* Licht., is the same. See Douglas, Ent. Mo. Mag., XXIII, 239; Morgan, Ent. Mo. Mag., XXV, 350. It occurs on apple, plum, cherry, and *Calluna vulgaris*. Also on peach at Isleworth, England (G. M. Fenn.). I found English specimens of this species to be attacked by a fungus similar to that which destroys American species of *Diaspidiotus*. I have seen it from Alameda, Cal. (Div. Ent., 351k.)

A. (*Diaspidiotus*) **oxyacanthæ** Sign.—♀ scale blackish-gray, exuviæ yellow; median lobes large; grouped glands present. On *Cratægus oxyacantha*.

A. (*Diaspidiotus*) **patavinus** Berl.—♀ scale oval, fuscous or fuliginous, exuviæ not central, length of scale nearly 1½ mm. ♀ much as in *A. spurcatus* or *A. vilis*, median lobes large and broad, second lobes low, separated by a wide interval from first, plates serrate, four or five groups of ventral glands. On bark of cherry. Italy. (Riv. Pat. Veget., IV, 350.)

A. (*Targionia*) **signoreti** Comst.—♀ scale black, very convex, exuviæ central. On *Cineraria maritima*. France. (Sign., Essai, 1870, p. 106; Comst., Cornell Rep., 1883, p. 82.) *Targionia nigra* Sign. is the same.

A. (*Diaspidiotus*) **spurcatus** Sign.—♀ scale blackish-brown, exuviæ yellow. Grouped glands present. On poplar. France. Essai, 1869, p. 138. A variety on *Platanus orientalis* in Italy. (Berl. and Leon., Cherm. Ital., Fasc. 1.)

A. (*Diaspidiotus*) **tiliæ** Sign.—♀ scale gray; only two lobes; grouped glands present, lateral groups of 9 or 10, median group of 7 or 8. This species is probably widely distributed in Central Europe; Dr. M. Hollrung has a reference to it in his Halle Bulletin of 1894.

A. (*Diaspidiotus*) **villosus** Targ.—♀ scale circular, grayish, depressed, exuviæ not central. ♀ with two lobes; groups of ventral glands of about 3 each. On leaves of olive.

A. (*Diaspidiotus*) **vitis** Sign.—♀ scale dark gray, exuviæ more or less covered; when rubbed the exuviæ are brilliant black. ♀ with only two lobes. On *Vitis*, near Nice; on raisins from Algiers.

A. (*Diaspidiotus*) **zonatus** Frauenf.—♀ scales gray or even nearly black, exuviæ reddish-yellow. ♀ with two pairs of lobes; grouped glands usually absent, but once reported as present by Morgan. The ♀ scales occur upon the branches, the ♂ scales upon the leaves, of oak. Widely distributed in Europe. *A. quercus* Sign., is the same. See Morgan, Ent. Mo. Mag., XXIV, 207, and XXV, 120; and Newstead, Ent. Mo. Mag., N. S., IV. 279. 1893. Morgan figures the ♂.

Japanese.

A. (*Diaspidiotus*) **andromelas** Ckll.—Resembles *A. perniciosus;* exuviæ of male scale wholly black, without any light dot and ring. On "*Photenia glauca*"—I find no such name in the Index Kewensis.

A. (*Pseudaonidia*) **duplex** Ckll.—♀ scale subcircular, moderately convex, dark blackish brown; exuviæ nearly at the side, orange. ♀ with very large median lobes, and three other pairs of very small lobes; plates scale-like; four large groups of ventral glands, and two orifices representing the median group; lattice-work pattern as in *A. theæ*. Japan. On camellia, orange, camphor, azalea, tea, *Olea fragrans*, etc. On azalea in Washington, D. C. (Div. Ent.)

A. (*Diaspidiotus*) **perniciosus** var. **albopunctatus** Ckll.—♂ scale with the pale dot and ring very distinct. Japan. On orange. Also found by Mr. Craw on plum from Japan.

A. (*Odonaspis*) **secretus** Ckll.—♀ scale white, shiny; exuviæ exposed, shiny, rather large, very pale yellow, placed rather to one side. ♀ when adult with a single (median) lobe, as is the case also with *A. unilobis;* two elongated groups of ventral glands, with 80 to 90 orifices in each. On bamboo in Japan; on *Arundinaria* in Ceylon. (Green, Coccidæ of Ceylon, p. 47, Pl. XV.)

Nearctic.

A. (*Diaspidiotus*) **æsculi** Johns.—♀ scale about 2½ mm. diam., dirty gray, exuviæ covered, orange-red when rubbed. ♀ yellow, only one pair of lobes, plates simple, spines prominent; four groups of ventral glands, cephalolaterals 5 to 17, caudolaterals 4 to 11. On bark of *Æsculus californica*. California. (Bull. Ill. Lab. N. H., IV, 387.)

A. (*Diaspidiotus*) **ancylus** Putn.—♀ scale nearly circular; exuviæ sublateral, reddish when the covering film is removed. The ♀ has ventral grouped glands. On ash, maple, beech, linden, oak, osage orange, peach, hackberry, bladder nut, and water locust. Iowa, New York, etc. Putnam, in Trans. Iowa Hort. Soc., 1877, p. 321, says the scale is usually of a light drab color, which certainly does not accord with what we commonly know as *ancylus*. However, he probably examined old scales, which eventually become pallid; and from the rest of his writings on the insect there can hardly be any doubt as to what was intended. He refers to the eggs.

A. (*Hemiberlesia?*) **bigeloviæ** Ckll. n. sp. (Fig. 12.)—♀ scale on twigs, like that of a *Hemiberlesia*, size and shape of *A. rapax*, but dull grayish-brown; exuviæ placed to one side as in *rapax*, when rubbed shining black, but more or less covered by a film of white secretion. Removed from twig the scales leave a white patch. ♀ circular, deep brownish-orange; no groups of ventral glands; no plates; lobes subobsolete. See the figure, which is from a ♀ full of embryos. Los Angeles, Calif., on *Bigelovia brachylepis*. (Div. Ent., 4973, coll. by D. W. Coquillett.) I do not know whether or not to consider this an extremely degenerate type of *Hemiberlesia;* it is certainly very peculiar.

A. (*Diaspidiotus*) **coloratus** Ckll.—♀ scale about 1½ mm. diam., broad oval, flat, dull pale orange-brown; exuviæ concolorous, first skin somewhat paler. ♀ much like *uvæ*; ventral glands present. On *Chilopsis* in the Rio Grande Valley, N. Mex.

A. (*Diaspidiotus*) **comstocki** Johns.—♀ scale rather flat, cream-buff, the part covering the exuviæ brownish or concolorous. ♀ pale yellow; two pairs of well-developed lobes, the tips of the median pair below the level of the tips of the second pair, after the manner of *A. destructor;* 4 groups of ventral glands, cephalolaterals of 6, caudolaterals of 4. On leaves of sugar maple. Illinois and New York. (Bull. Ill. Lab. N. H., IV, 383.)

A. (*Hemiberlesia*) **convexus** Comst.—♀ scale similar to that of *rapax*, but more opaque. Grouped glands present. On poplar and willow.

A. (*Hemiberlesia*) **cydoniæ** Comst.—♀ scale like that of *rapax*. ♀ with four groups of ventral glands, differing from *convexus* in having only two pairs of interlobular incisions, and the plates more prominent. On quince in Florida. Maskell reports it on *Citrus* from Samoa, and Green on fig, *Citrus*, etc., at Pundaloya, Ceylon. Dr. Howard informs me that it has never been received at the Department of Agriculture since 1880, so it must be rare in America.

A. (*Diaspidiotus*) **forbesi** Johns.—♀ scale much like that of *A. ancylus*. ♀ yellowish, with two pairs of lobes; 5 groups of ventral glands. On cherry, apple, pear, plum, quince, currant, and perhaps other trees. Illinois, and Mesilla, N. Mex.

A. (*Diaspidiotus*) **howardi** Ckll.—♀ scale flat, circular, pale grayish; exuviæ covered, dull orange. ♀ very similar to that of *A. ancylus*, but two pairs of lobes. On plum, Canyon City, Colo.; Albuquerque, N. Mex.

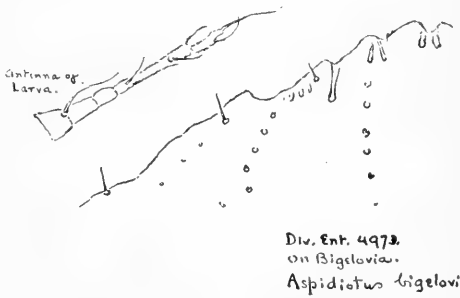


FIG. 12.—*Aspidiotus bigeloviæ* (original).

A. (*Diaspidiotus*) **juglans-regiæ** Comst.—♀ scale circular, flat, grayish-brown, exuviæ covered; diam. of scale, 3 mm. ♀ with two or three pairs of lobes; grouped glands present. On English walnut in California; on locust, pear, and cherry in New York and District of Columbia.

var. **pruni** Ckll.—♀ with the oval pores more numerous, the fourth or external row of about 20. On plum, Las Cruces, N. Mex.

var. **albus** Ckll.—♀ scale white; exuviæ orange-red, covered by white secretion. Mesilla Valley and Las Vegas, N. Mex.

A. (*Pseudodiaspis* n. subg.) **larreæ** Ckll., n. sp. (Fig. 13.)—♀ scales abundant on a stem of *Larrea tridentata;* scale about 2 mm. diam., flat, irregular, round to suboval, dull white with a slightly creamy tint; exuviæ not visible in the mature scale, but in younger scales the elongate-oval, pale straw-colored first skin is exposed, sublateral or even quite lateral. ♀ circular, not chitinous; only one pair of lobes; these broad and low, close together but not touching; no plates; no groups of ventral glands. The ♀'s contain embryos, which even after boiling remain sepia brown.

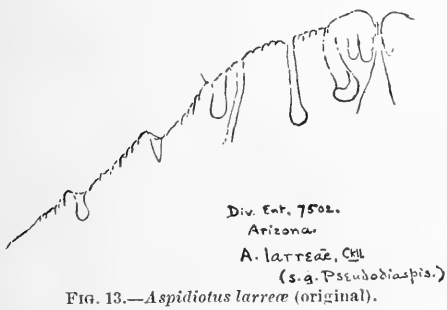


FIG. 13.—*Aspidiotus larreæ* (original).

A dried ♀ is oval, orange, with prominences on the margin. ♂ scale small, elongate, mytiliform, white, with the elongate first skin projecting at the small end, like a *Mytilispis*. Yuma, Ariz. (Div. Ent., 7502, coll. by H. G. Hubbard). This curious species is for the present left in *Aspidiotus*, because it seems to have points in common with the Indian *A. moorei*, Green. *Pseudodiaspis* will, however, no doubt eventually be regarded as a distinct genus, on account of the mytiliform ♂ scale and other characters.

A. (*Melanaspis*) **obscurus** Comst.—♀ scale very dark gray, only slightly convex; exuviæ sublateral, covered; diameter of scale 3 mm.; ♂ scale oval. ♀ with three pairs of well-developed lobes; 5 groups of ventral glands. On willow-oak at Washington, D. C.

A. (*Chrysomphalus*) **perseæ** Comst.—♀ scale circular, flat; exuviæ nearly central and covered; outer part of scale dark reddish-brown, that covering exuviæ from dark gray to black; diam. of scale from 1½ to 2 mm. Has a general resemblance to *A. ficus*. ♀ with 4 groups of ventral glands. On *Persea cärolinensis*, Florida. Mexico, on cocoanut palm.

A. (*Xerophilaspis*) **prosopidis** Ckll.—♀ scale about ½ mm. diam., slightly convex, circular to very broad pyriform, pitch-black, with large uncovered exuviæ, which may be slightly greenish or brownish. ♀ with four small lobes, no groups of ventral glands; a cephalic protuberance after the manner of *personatus*. Near Phœnix, Ariz., on *Prosopis*.

A. (*Chrysomphalus*) **smilacis** Comst.—♀ scale circular; exuviæ central; color brown to very dark gray; exuviæ marked by a white dot and ring. No grouped glands; 3 pairs of lobes, median smallest, second and third pairs notched. On *Smilax* at Woods Holl, Mass.

A. (*Chrysomphalus*) **tenebricosus** Comst.—♀ scale very dark gray; the protuberance indicating the position of the exuviæ marked by a white dot and concentric ring, but smooth and black in rubbed specimens. The scale is very convex, diam. 1½ mm. ♂ scale oval. On *Acer rubrum;* Washington, D. C.

A. (*Diaspidiotus*) **townsendi** Ckll.—♀ scale 1½ mm. diam., circular or slightly oval, quite flat, thin, grayish-white; exuviæ covered, pale orange. ♀ orange; 2 pairs of rounded lobes, four groups of ventral glands, cephalolaterals 4 to 8, caudolaterals 5. On leaves of some tree. Coahuila, Mexico. (Bull. 4, Tech. Ser., Div. Ent., p. 32.)

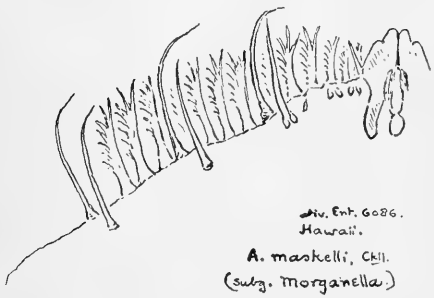


FIG. 14.—*Aspidiotus maskelli* (original).

A. (*Hemiberlesia*) **ulmi** Johns.—♀ scale quite convex, whitish, exuviæ orange-yellow. ♀ lemon-yellow, only one pair of lobes, no groups of ventral glands. On trunk of *Ulmus americana* at Urbana, Ill. Although Johnson found no ventral grouped glands, he alludes to eggs.

A. (*Diaspidiotus*) **uvæ** Comst.—♀ scale flat, nearly circular, light yellow-brown; exuviæ bright yellow, covered with a white secretion. ♂ scale elongated. ♀ with second and third pairs of lobes obsolete; grouped glands present. On grapevines, Indiana, etc.; on hickory in Florida.

Sandwich Islands.

A. (*Morganella, n. subg.*) **maskelli** Ckll. n. sp. (Fig. 14.)—♀ scale 1 mm. diam., tolerably convex, circular to broad oval, pitch-black; exuviæ concolorous, very inconspicuous, placed toward the side. ♀ with no groups of ventral glands. Differs from *A. longispinus* by the contiguous lobes, the first pair of spines short, three following pairs very long, and thirteen strongly serrated and divided plates on each side of the lobes. It is evidently what Maskell recorded as *A. longispina* in Trans. N. Z. Inst., xxvii, 38. Div. Ent. 6086, "on Ohia tree, from W. S. Wait, Kailua, N. Kona, Hawaii, 23 Dec., 1893." The subg. *Morganella* (after the describer of one of the species) will be known by the closely adjacent or contiguous median lobes, which are long and slender, the absence of other lobes, the anal orifice at base of lobes, and especially the very long spines.

Neotropical.

A. (*Selenaspidus*) **articulatus** Morg.—♀ scale very flat, grayish-white, appearing orange or rufous in the middle, mainly from the insect showing through. The scale looks like that of *A. aurantii*, but if it is lifted up, the flat orange ♀, with a deep constriction between the cephalothorax and the abdomen, is easily seen with a hand lens sufficiently for identification. It occurs on the leaves of palms and on a variety of other plants. West Indies, Demerara, Mexico, and lately reported by Newstead from Lagos, W. Africa. (Ent. Mo. Mag., xxv, 352.)

A. (*Chrysomphalus*) **biformis** Ckll.—♀ scale about 2 mm. diam., very dark brown, circular to broadly oval, depressed, granulose; exuviæ nipple-like, dark red-brown, placed to one side of center. ♂ scale elongate. ♀ with three pairs of lobes. On orchids. Jamaica and Trinidad. Also from Central America; the specimens showing four groups of ventral glands, rather scattered, cephalolaterals 4 or 5, caudolaterals 5.

var. **cattleyæ** Ckll.—Exuviæ black. On *Cattleya bowringiana*. Jamaica. (Gard. Chron., May 6, 1893, p. 548.)

var. **odontoglossi** Ckll.—Exuviæ pale, black when rubbed. On *Odontoglossum grande*. Jamaica. (Gard. Chron., May 6, 1893, p. 548.)

A. (*Chrysomphalus*) **bowreyi** Ckll.—♀ scales crowded on the plant, elongate, gray, with the blackish exuviæ toward one end. ♀ with three pairs of lobes, none very prominent, margin serrate beyond the lobes; four groups of ventral glands, cephalolaterals about 7, caudolaterals about 8. On *Agave rigida*. Jamaica. (Ent. News, 1894, p. 59.)

A. (*Hemiberlesia*) **crawii** Ckll.—♀ scale about 2 mm. diam., circular, moderately convex, dull reddish-gray, rather pale; exuviæ nearly marginal, concolorous, inconspicuous, except the first skin, which is marked by a little shining yellowish prominence. Scales largely covered by the red-brown epidermis. Removed from the twig they leave a conspicuous white mark. ♀ similar to *cydoniæ;* four groups of ventral glands, caudolaterals 4, cephalolaterals 5. On twigs of grapevine from Mexico, found by Mr. Alex. Craw in the course of his quarantine work. The passenger who brought the plants said they were sarsaparilla, but Mr. Craw thinks it is grapevine, and I am of the same opinion.

A. (*Chrysomphalus*) **dictyospermi** Morg.—♀ scale grayish-white, depressed, oval, exuviæ central, light yellow, center of larval skin dark orange. ♀ with three pairs of lobes; a conspicuous pair of long, serrated plates laterad of third lobe. On *Dictyospermum album*. Demerara. (Ent. Mo. Mag., 1889, p. 352.) There are four groups of ventral glands, cephalolaterals 3 or 4, caudolaterals 2. It occurs as a hothouse species in the United States.

var. **arecæ** Newst.—♀ scale more circular, deeper colored, with a nipple-like prominence surrounded by a depression, beyond which is a strong circular ridge. On *Areca triandra*. Demerara. (Ent. Mo. Mag., 1893, p. 185.)

var. **jamaicensis** Ckll.—♀ scale more circular, red-brown, no conspicuous central depression or ridge. Jamaica. On *Cycas* and rose.

A. (*Diaspidiotus*) **diffinis** Newst.—♀ scale convex, slightly elongate, grayish-brown, exuviæ covered, brown when rubbed. ♀ with three pairs of lobes, plates and ventral grouped glands wanting. Demerara. (Ent. Mo. Mag., 1893, p. 186.)

var. **lateralis** Ckll.—♀ with distinct plates. Jamaica, on *Jasminum*. This is very near to *punicæ*, but the scale is brownish-white to brown, with the exuviæ away from the center, and the groups of ventral glands seem to be absent.

A. (*Chrysomphalus*) **ficus** Ashm.—♀ scale circular, 2 mm. diam., black or blackish, with the covered exuviæ reddish or orange. ♀ with three pairs of well-developed lobes and four groups of ventral glands. On *Ficus nitida* and *Citrus*. Florida, Cuba, Mexico, Australia, Ceylon, Egypt. It lives on a great variety of plants. Mr. Pettit sent it to me from the Shaw Botanic Garden, St. Louis, on *Laurus virginiana*. It is common in the West Indies. Mr. Hy. Tryon states

that he bought in Brisbane some imported American apples which had numerous *A. ficus* on the rind; but did he perhaps mistake the species? Its food plants at Brisbane he says are orange, *Myrtus hillii*, camphor laurel, *Atlantia buxifolia*, and *Castaneospermum*.

A. (*Aspidiotus s. str.?*) **hartii** Ckll.—♀ scale subcircular to oval, about 1½ mm. diam., moderately convex, dull brownish-gray, with a slight purplish tint (*sacchari* is similar), exuviæ shining pale straw-color. ♀ with two pairs of well-developed lobes, branched plates, five groups of ventral glands. On yam tubers. Trinidad, W. I.

var. **lantii** Ckll.—Median lobes entire, as in *hartii;* no groups of ventral glands. Trinidad. The median lobes of *sacchari*, which this resembles, are very distinctly notched.

A. (*n. subg.?*) **latastei** Ckll.—♀ scale about 1⅔ mm. diam., circular, strongly convex, concentrically ridged, white, with the covered pale orange exuviæ to one side. ♀ with median lobes large, wide apart, second small, third almost obsolete; four groups of ventral glands, of 5 each. Chile.

A. (*Morganella*) **longispinus** Morg.—♀ scale dark, convex, less than a mm. broad; exuviæ central, covered, inconspicuous. ♀ with only one pair of lobes, these long, notched without; long simple plates, and very long spines. On *Cupania sapida*. Demerara. (Ent. Mo. Mag., xxv, 352.)

A. (*Chrysomphalus*) **mangiferæ** Ckll.—♀ scale circular, flattened, with central, covered, nipple-like exuviæ, which are reddish. Median lobes largest, second pair nearly as large, third pair small, fourth rudimentary; a pair of very large spine-like plates in the region of 3rd and 4th lobes. On leaves of mango. Jamaica. (Journ. Inst. Jamaica, i, 255.)

A. (*Chrysomphalus*) **mimosæ** Comst.—♀ scale resembling that of *tenebricosus;* very dark gray, convex, exuviæ covered, its position marked by a white dot and ring. 3 pairs of lobes; no group of ventral glands. On *Mimosa;* Tampico, Mexico. (2nd Cornell Rep., 1883, p. 62.)

A. (*Melanaspis*) **nigropunctatus** Ckll.—Much like *A. obscurus*. ♀ scale 3 mm. diam., dirty gray; exuviæ sublateral, pitch-black, with a narrow reddish margin; at first covered by a film of whitish secretion. ♀ with five groups of ventral glands, cephalolaterals 16 or more, caudolaterals 10 or 11, median 7 or 8. On "trueno," San Luis Potosi, Mexico. (Bull. 4, Tech. Ser., Div. Ent., p. 31.)

A. (*Hemiberlesia*) **palmæ** Morg. & Ckll.—♀ scale much like that of *rapax*. ♀ differing by the distinct though small second and third lobes, median lobes wider apart, plates longer and much branched at tips, 4 groups of ventral glands. On cocoanut and banana, and rarely on other plants. West Indies.

A. (*Mycetaspis*) **personatus** Comst.—♀ scale very small and convex, circular, dark gray or black. No groups of ventral glands. West Indies.

A. (*Diaspidiotus*) **punicæ** Ckll.—♀ scale circular or nearly so, white, first skin shining metallic. ♀ orange, median lobes large and prominent, second pair small, third rudimentary; grouped glands present. ♂ dull yellow. On pomegranate in Jamaica; on cocoanut in Dominica. (Journ. Inst. Jamaica, i, 255.)

A variety of this on a palm at the Department of Agriculture, Washington, D. C. (Div. Ent., 6982), has broader lobes and a flatter scale. It appears to be identical with the form found by Mr. Barber on cocoanut in Dominica. This is a good deal like the Ceylonese form, which Green calls *A. cydoniæ;* and while *punicæ* and *cydoniæ* seem sufficiently distinct, with the var. of *punicæ* and the Ceylonese *cydoniæ* there is formed a sufficiently continuous series to call for further investigation. Whatever may be the final result as to the status of the species concerned, the interesting fact remains that here we have *Diaspidiotus* running completely into *Hemiberlesia* as it passes southward. Another related species is *A. greenii*.

A. (*Chrysomphalus*) **reniformis** Ckll.—♀ scale circular, diam. 2 mm., flat, pale reddish-brown; exuviæ concolorous or slightly darker, covered, but both skins very

distinctly visible, large, laterad of the middle; first skin when rubbed shining coppery. ♀ reniform, with four very low, broad, inconspicuous lobes, 4 groups of ventral glands, cephalolaterals 8, caudolaterals 4 to 7. Tehuantepec City, Mexico Collected by Prof. Townsend.

A. (*Aspidiotus s. str.?*) **sacchari** Ckll.—♀ scale white, becoming grayish, more or less oval, first skin brown, second orange. ♂ scale elongate. ♀ very pale yellowish, with a slight pink tinge; median lobes rather large, 2nd pair smaller, 3rd rudimentary. On sugar cane, Jamaica. (Journ. Inst. Jamaica, i, 255.)

A. (*Chrysomphalus*) **scutiformis** Ckll.—♀ scale superficially rather like *A. ficus*, but large, very flat, with large orange exuviæ, not nipple-like. The scales are occasionally nearly white. ♀ very much like *perseæ*. On *Citrus*, etc., Mexico.

A. (*Hemiberlesia*) **tricolor** Ckll.—♀ scale 1⅜ mm. diameter, approximately circular, very little convex, white with a brownish stain; exuviæ central or sublateral, covered by a film of secretion; first skin black or dark brown, second skin deep orange. ♀ with only a single pair of lobes, these large; no groups of ventral glands. Allied to *ulmi* and *rapax*. Salina Cruz, Mexico. Collected by Prof. Townsend.

A. (*Chrysomphalus?*) **yuccæ** Ckll.—♀ scale oval, dirty whitish; exuviæ covered, inconspicuous, pale brown; when rubbed becoming very conspicuous, dark brown or black. ♀ with three pairs of lobes, only the median well developed. On *Yucca*. Coahuila, Mexico. (Bull. 4, Tech. Ser., Div. Ent., p. 32.)

Fiji Islands.

A. (*subg. nov.?*) **vitiensis** Mask.—♀ scale grayish white, occurring thickly massed; exuviæ subcentral, yellow. ♀ with very large, widely apart, median lobes, and others smaller; four conspicuous forked plates; four groups of ventral glands, caudolaterals about 15, cephalolaterals 6 to 10. On various forest trees. (N. Z. Trans., xxvii, 40.)

New Zealand.

(Most of the New Zealand and Australian species seem not to fit well in the subgenera of the Northern Hemisphere It will be necessary to make a special study of them before they can be classified subgenerically.)

A. (*subg.?*) **atherospermæ** Mask.—♀ scale circular, flat, brown; exuviæ forming a lighter protuberance in center. ♀ light yellow; several lobes, the two median pairs largest; scale like serrated plates; four groups of ventral glands. The ♂ scale is oval. On *Atherosperma*. New Zealand. (N. Z. Trans., xi, 198.)

A. (*Aspidiotus s. str.?*) **carpodeti** Mask.—♀ scale usually light brown but rather variable, convex, circular; exuviæ central. ♀ with large median lobes, second pair much smaller; four groups of ventral glands. ♂ scale narrow, with parallel sides. On *Carpodetus* and *Vitex*. (N. Z. Trans., xvii, 21.)

A. (*subg.?*) **corokiæ** Mask.—♀ scale circular, slightly convex, yellow or (rarely) white; exuviæ central, yellow. ♀ with no distinct groups of ventral glands. On *Corokia*. (N. Z. Trans., xxiii, 2.)

A. (*subg.?*) **dysoxyli** Mask.—♀ scale circular, somewhat convex, brown. ♀ bright yellow; six lobes, of which only the median two are conspicuous; four groups of ventral glands. ♂ scale oval. On *Dysoxylon spectabile*. (N. Z. Trans., xi, 198.)

A. (*subg?*) **sophoræ** Mask.—♀ scale nearly circular, flat, bluish gray. ♀ greenish-yellow; median lobes conspicuous, plates as in *nerii*, five (sometimes four) groups of ventral glands. ♂ scale oval. On *Sophora tetraptera*. (N. Z. Trans., xvi, 121.)

Australia.

A. (*subg.?*) **acaciæ** Morg.—♀ scale circular, convex; exuviæ central, orange-yellow; diam. of scale about 1 mm. ♀ with one pair of lobes, no groups of ventral glands. On *Acacia pycnantha*. Tasmania. (Ent. Mo. Mag., 1889, p. 353.) Maskell reports it on *Eucalyptus* from New South Wales.

var. **propinquus** Mask.—Exuviæ deeper red. ♂ scale elliptical, white. ♂ dark red. On *Acacia* and *Hakea saligna*, New South Wales. (N. Z. Trans., xxv, 205.)

A. (*subg.?*) **bossieæ** Mask.—♀ scale circular, convex, dirty white to yellow, sometimes dark brown, soft and woolly looking; exuviæ central, very small and inconspicuous, yellow. ♀ dark brown, with two rounded lobes, and a second pair rudimentary; no groups of ventral glands. On *Bossiea procumbens*. (N. Z. Trans., xxiv, 11.)

A. (*subg.?*) **casuarinæ** Mask.—♀ scale dark yellowish-brown, circular, rather convex; exuviæ yellow. ♀ yellow, 6 lobes, no groups of ventral glands. ♂ scale elongated. On *Casuarina equisetifolia*. (N. Z. Trans., xxvi, 66.)

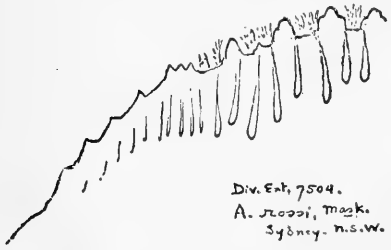


FIG. 15.—*Aspidiotus rossi* (original).

A. (*subg.?*) **ceratus** Mask.—♀ scale snow white, circular, convex, usually occurring massed; exuviæ central, faintly yellow, with a white covering. ♀ orange, two lobes only, with a pair of club-shaped processes arising from their inner bases; no groups of ventral glands; a peculiar widely bifid plate on the margin some distance from each lobe. On *Acacia stenophylla*. (N. Z. Trans., xxvii, 39.)

A. (*Chrysomphalus*) **cladii** Mask.—♀ scale rich dark brown, the margin orange-red, and the central exuviæ dark yellow. ♂ scale elongated. ♀ with no groups of ventral glands. On *Cladium*. (N. Z. Trans., xxiii, 3.) On aloe in Natal, as well as various localities in Australia, where it occurs on *Xerotes* and *Lepidosperma* as well as *Cladium*.

A. (*subg.?*) **eucalypti** Mask.—♀ scale circular, slightly convex, dirty white; exuviæ central, very inconspicuous. ♀ with large median lobes; no groups of ventral glands, but rows of pores along the margins of the hindmost segments; a deep constriction behind the cephalothorax, after the manner of *articulatus*. ♂ scale narrow, elongated; exuviæ terminal, as in *Diaspis*. On *Eucalyptus*. (Tr. Roy. Soc. S. Australia for 1888.)

var. **comatus** Mask.—Distinguished by the nonincised lobes and the longer hairs in couples. Found on *Eucalyptus viminalis*. (N. Z. Trans., xxviii, 385.)

A. (*Chentraspis.*) **extensus** Mask.—♀ scale dirty yellow or brown, convex, first skin black. ♀ dark brown, with a single pair of contiguous lobes, after the manner of *Chionaspis minor;* no groups of ventral glands. ♂ dark brown. On *Eucalyptus capitellata*. (N. Z. Trans., xxvii, 41.)

A. (*Aspidiotus s. str.*) **fimbriatus** Mask.—♀ scale circular, flat, very thin, first skin uncovered. ♀ yellow, three pairs of lobes, scale-like plates; four groups of ventral glands, cephalolaterals and caudolaterals each of about 10 to 14. On *Eugenia smithii*. (N. Z. Trans., xxv, 208.) Described as a doubtful *Diaspis*, on account of the elongated form of the ♀.

A. (*Chrysomphalus*) **fodiens** Mask.—♀ scale circular, slightly convex, grayish or reddish-brown; exuviæ central, bright orange, forming a slight boss, often covered with a thin grayish coating. ♀ orange, 6 lobes, scale-like serrated plates; 4 groups of ventral glands, not over 5 orifices in a group. Very near to *cladii*, but smaller. On *Acacia*. (N. Z. Trans., xxiv.)

A. (*Phaulaspis*) **hakeæ** Mask.— ♀ scale circular, slightly convex, grayish-white; exuviæ dark orange, central. ♀ orange-yellow, no lobes in adult, but four lobes in second stage; no groups of ventral glands. ♂ dark red. Related to *A. acaciæ*. On *Hakea*. (N. Z. Trans., xxviii, 384.)

A. (*Chrysomphalus*) **rossi** Mask—Fig 15.— ♀ scale normally circular, very slightly convex, deep dull brown, almost black; exuviæ central, small, forming a little boss which is sometimes yellowish. ♀ with 6 lobes; 4 groups of ventral glands, not over 8 orifices in a group. On oleander, *Eucalyptus*, *Ricinocarpus*, etc. Also in Ceylon, on *Capparis*. (N. Z. Trans., xxiv, 11.)

A. (*Aspidiotus s. str.*) **subrubescens** Mask.— ♀ scale reddish-brown, subcircular, flat; exuviæ central, forming a small slightly elevated boss. ♂ scale white. ♀ with 6 lobes, and serrated plates; four groups of ventral glands. On *Eucalyptus* (N. Z. Trans., xxiv, 9); on *Pittosporum* from Australia (Div. Ent., No. 7399).

A. (*Chentraspis*) **unilobis** Mask.— ♀ scale whitish, but usually blackened by fungus growth, circular, slightly convex; exuviæ central, orange. ♀ dark orange, with a single, median, lobe, after the manner of *Chionaspis quercûs;* no groups of ventral glands. On *Acacia*. (N. Z. Trans., xxvii, 40.)

A. (*subg.?*) **virescens** Mask.— ♀ scale subcircular, flat, grayish-white; exuviæ subcentral, first skin distinctly green, second greenish in middle and yellowish on border. ♀ yellow with a greenish tinge; six lobes, not close together; serrated scale-like plates; 4 groups of ventral glands, cephalolaterals of 17 to 21, caudolaterals 8 to 13. On *Eugenia smithii*. (Tr. N. Z. Inst., xxviii, 384.)

Oriental.

A. (*Mycetaspis?*) **artocarpi** Green.— ♀ scale less than 1 mm. diam., blackish, very convex; first skin exposed, central, dark brown with a pale reddish margin. Scale leaving a white scar surrounded by a black ring, after the manner of *personatus*. ♀ deeply constricted between cephalothorax and abdomen, four pairs of tooth like lobes, no plates, no grouped ventral glands. On leaves of *Artocarpus integrifolius*. Bombay. (Ent. Mo. Mag., 1896, p. 200.)

A. (*Aspidiotus, s. str.*) **excisus** Green.— ♀ scale convex, of irregular outline, thin, semitransparent, whitish or very pale ochreous; exuviæ yellow, approximately central. ♀ with the median lobes sunk in a deep, squarely cut recess, an exaggeration of the condition in *A. destructor;* four groups of ventral glands, cephalolaterals 8 to 15, caudolaterals 7 to 9. On leaves of *Cyanotis pilosa*. Ceylon.

A. (*Diaspidiotus*) **greenii** Ckll.—See fig. 7. This is founded on the supposed *cyanophylli* found by Green on *Cycas* at Kandy, Ceylon, specimens having been kindly sent by Mr. Green.*

A. (*n. subg.*) **inusitatus** Green.— ♀ scale very large, flattish, becoming elongated, even to 7½ mm. long, brownish white or brownish fulvous; exuviæ yellow, more or less concealed. ♀ with no lobes, and no grouped ventral glands. On bamboo. Ceylon. (Coccidæ of Ceylon, p. 49.) I have not examined specimens of this

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* Since writing the above I have examined specimens of an *Aspidiotus* on cocoanut palms from Mazatlan, Mexico, forwarded by Mr. Alex. Craw. These are evidently Green's supposed typical *cyanophylli*, but they are allied to *Diaspidiotus*, having the incisions between the lobes very well marked. The glands in the groups are few, cephalolaterals 4 or 5, caudolaterals 3. After studying these insects, I begin to feel less sure regarding *cyanophylli* than I had been. They certainly *may* be the insect described by Signoret, notwithstanding certain discrepancies. They also agree excellently with Comstock's *cyanophylli*, except that Comstock not only fails to figure the incisions, but in his table places the species in the section without them. If the examination of Signoret's types eventually proves that the present insect really is *cyanophylli*, then the name *greenii* will have to be confined to the variety from *Cycas*, on which it is primarily based. But in the meanwhile, I should prefer to include the Mazatlan insect under *greenii*. The species is probably of neotropical origin.

curious species; perhaps Mr. Green will propose a subgeneric (or generic) name for it.

A. (*n. subg.*) **moorei** Green — ♀ scale 2½ mm. diam., rugose and colored like the bark on which it rests; exuviæ reddish-brown. ♀ reddish-brown, skin entirely chitinous, body divided by deep constrictions into three subequal parts, three pairs of lobes, plates apparently absent, no grouped ventral glands; long chitinous processes arising from the first interlobular interval, but none in the second or beyond. On bark of *Grislea tomentosa*. Madras. (Ent. Mo. Mag., 1896, p. 199.)

A. (*Cryptophyllaspis*) **occultus** Green.— ♀ pale yellow; no groups of ventral glands. In minute galls on leaves on *Grewia orientalis*. Ceylon. The reader should refer to Green's "Coccidæ of Ceylon," p. 41, and Pl. XI, for an account of this very remarkable insect.

A. (*subg.?*) **orientalis** Newst.— ♀ scale about 1½ mm. diam., brownish-yellow or straw color; exuviæ covered by a nipple-like prominence which is darker than the rest. ♀ with three pairs of lobes, plates simple and hair-like, four groups of ventral glands of about 5 each. Madras. (Ind. Mus. notes, iii, 6.)

A. (*Diaspidiotus*) **osbeckiæ** Green.—"Allied to *nerii*," but scale opaque, brownish, and marginal fringe of ♀ different. On stems of *Osbeckia*. Ceylon. The excellent figures in Green's work show that this species really belongs with *Diaspidiotus*, and therefore is only superficially like *nerii*. The median lobes are fairly wide apart, and the second lobes well trilobed; there are four groups of ventral glands, and a single orifice representing the fifth group.

A. (*Aspidiotus s. str.*) **putearius** Green.— ♀ scale round, flat, or slightly concave "forming an operculum to the pit-like depression in which the insect rests;" color very pale brownish ochreous, semiopaque; exuviæ central, pale yellow. ♀ without grouped ventral glands. On *Strobilanthes*. Ceylon. This insect is of interest as showing the first stage toward gall formation, the advanced or completed stage of the same process being exhibited in the extraordinary *A. occultus*. The Australian *A. fodiens*, belonging to a different group, forms pits in the leaves of *Acacia*, but no gall-inhabiting *Aspidiotus* is yet known from Australia.

A. (*Pseudaonidia*) **theæ** Mask.— ♀ scales clustered thickly on twigs, as nearly circular as their numbers and position will permit, slightly convex, light brown, with a very thin coat of white secretion; exuviæ yellow, very small, near the margin. ♀ brown; four lobes, the second pair smaller; 4 large groups of ventral glands. On tea plant. India. The insect has a patch of "lattice work" on dorsal surface of ♀, after the manner of *Ischnaspis*. This is not *A. theæ* Green, "Insect pests" (1890), p. 13, which consists of female *Howardia biclavis*, with the ♂ of some other species, apparently a *Chionaspis*.

A. (*Aspidiotus s. str.*) **transparens** Green.—There are four groups of ventral glands, cephalolaterals 6 to 11, caudolaterals 4 to 6. Ceylon, on tea, etc., now referred by Green to *latoniæ*, but very likely distinct.

A. (*Pseudaonidia*) **trilobitiformis** Green.— ♀ scale broad and flat, opaque, reddish-brown. ♀ with the segments strongly marked, a deep transverse groove behind the cephalic portion; hind portion with a well-marked reticulated patch. On leaves of *Dalbergia*. Ceylon. Mr. Green says of this: "Very closely allied to (possibly only a variety of) *A. theæ* Maskell." I do not think the affinity is so very close, though they have some striking features in common. I think *duplex* is closer to *theæ*.

Ethiopian.

A. (*subg.?*) **maculatus** Newst.— ♀ scale pure white, rather thick; exuviæ black, forming a large, conspicuous, central spot. ♀ with two pairs of lobes, median minute, rounded, second pair greatly elongated, plates well developed, no groups of ventral glands. Lagos. (Ent. Mo. Mag., 1896, p. 133.)

Patria Incerta.

A. (*Aspidiotus s. str.*) **aloes** Boisd.—♀ scale white; exuviæ central and yellow. Median lobes large; grouped glands present. Allied to *nerii*. On *Aloe umbellata*, Europe. (Signoret, Essai, 1869, p. 114).

A. (*Aonidiella*) **aurantii** Mask.—♀ scale light gray, but appearing orange or reddish from the insect showing through; exuviæ marked by a nipple-like prominence. ♀ reniform, three pairs of lobes, no groups of ventral glands. On *Citrus* trees in California, Australia, and the western Mediterranean region. On lignum-vitæ principally, never on *Citrus*, in Jamaica. A variety on *Podocarpus* in Japan, collected by Mr. Takahashi at Tokio. New Zealand, Fiji Is., Sandwich Is., Samoa, Tonga, New Caledonia; on cocoanut in Central America; on *Taxus* in Italy; on *Citrus japonica* at the University of Arizona, sent by Prof. Toumey.

var. **citrinus** Coquill.—A yellow variety. California; Japan. According to Howard, this occurs on the leaves and fruit, never on the bark. See Insect Life, Feb., 1894, p. 228. Howard records three parasites from v. *citrinus*, all different from the three bred from typical *aurantii*.

A. (*Aspidiotus s. str.*) **buddleiæ** Sign.—♀ scale circular, white; exuviæ yellow. Ventral grouped glands present. On *Buddleia salicina*, hothouses of the Luxembourg. Maskell reports it on *Acacia* in New Zealand.

A. (*Aspidiotus s. str.?*) **chamæropsis** Sign.—♀ scale elongated, transparent; exuviæ yellow and to one side. Lobes terminated by long hairs; grouped glands present. On *Chamærops australis*. (Essai, 1869, p. 118.)

A. (*Aspidiotus s. str.*) **cyanophylli** Sign.—♀ scale circular, brownish yellow; exuviæ central, bright yellow but covered by white secretion. Median lobes large; plates long and branched, 4 small groups of ventral glands, 3 to 5 in a group. On *Cyanophyllum*, Paris (Signoret); on *Ficus*, U. S. (Comstock, Cornell Rep. 1883, p. 59). On palm and *Cycas* in Ceylon, according to Green, but his insect is a different species, *A. greenii*, n. sp., at least so far as the form sent to me is concerned.

A. (*Aspidiotus s. str.*) **cycadicola** Boisd.—♀ scale circular, white; exuviæ central, yellow; median lobes large; grouped glands present. ♂ with the thoracic band large. On *Cycas revoluta*, Europe. (Signoret, Essai, 1869, p. 119).

A. (*Chrysomphalus*) **degeneratus** Leon.—♀ scale greenish, convex, about 1¼ mm. long. ♀ pale yellow, three pairs of lobes; serrated plates; chitinous processes at base of lobes hardly longer than the lobes; four groups of ventral glands, not over 4 in a group. On leaves of *Camellia japonica*. Italy. (Riv. Pat. Veget., IV, 345.)

A. (*Aspidiotus s. str.*) **destructor** Sign.—♀ scale circular, flat, yellowish or whitish; exuviæ large, central. ♀ with three pairs of lobes, or even a fourth clearly distinguishable, and scale-like divided plates; the level of the tips of the median lobes below or at any rate not above that of the tips of second lobes. *A. fallax* Ckll. and *cocotis* Newst. are the same. On palms and various other plants. West Indies, Demerara, Bourbon, Marquesas Islands, Laccadive Islands.

Distinguished at once from *nerii*, to which it is closely allied, by the larger exuviæ and the short median lobes not extending beyond the tips of the second lobes. The var. *fallax*, on mango in Antigua, shows the four pairs of lobes. (See Ent. Mo. Mag., March, 1894, p. 57.)

A. (*Aspidiotus s. str.*) **epidendri** Bouché.—Resembles *nerii*, but differs in the ♂. On *Epidendrum*, Europe. (Signoret, Essai, 1869, p. 121.) Maskell reports it on *Acacia* in New Zealand.

A. (*Aspidiotus s. str.?*) **kennedyæ** Boisd.—Resembles *nerii*. On *Kennedya*. (Nomen seminudum.)

A. (*Aspidiotus s. str.*) **lataniæ** Sign.—♀ scale a little elongated, clear yellow, translucid at center; exuviæ large. Median lobes large; four groups of ventral glands. On *Latania*. A hothouse species in Europe. Green reports it from Ceylon, but it is not certain that his insect is the true *lataniæ*.

A. (*Chrysomphalus*) **minor** Berl.—♀ scale brown, convex, very little over 1 mm. diam. ♀ yellow, three pairs of lobes, serrated plates; a couple of long plates laterad of third lobe, after the manner of *dictyospermi;* four small groups of ventral glands, not over 4 to a group. On leaves of *Pandanus,* in hort. Italy. (Riv. Pat. Veget., IV, 346.) This seems to me to be identical with *A. dictyospermi* var. *jamaicensis;* if not, it is at least extremely close to it.

A. (*Aspidiotus s. str.*) **myrsinæ** Sign.—Allied to *nerii.* On *Myrsina retusa* in the hothouses of the Luxembourg.

A. (*Aspidiotus s. str.*) **nerii** Bouché.—♀ scale flat, whitish; exuviæ exposed, central or nearly so, dull orange yellow. ♀ with three pairs of lobes, scale-like plates; four groups of ventral glands, caudolaterals about 7, cephalolaterals about 9. On oleander, *Melia, Yucca,* and a variety of other garden plants; very widely distributed, but not universal; very rare in the West Indies, only once found, viz: On olive in the Botanic Gardens, Grenada. Elsewhere in the neotropical region, Lataste found it at Santiago, Chili, while it occurs in several localities in Mexico. It is common enough in the United States. Berlese appears to have demonstrated what was before suspected, that *nerii* is but a variety of *A. hederæ.*

var. **limonii** Sign.—♀ with the end of the abdomen more elongated, and the plates larger, than in the type. Found on lemons in Europe. Also in the Sandwich Islands. (Essai, 1869, p. 125.)

A. (*Aspidiotus s. str.*) **palmarum** Bouché.—♀ scale white, circular; exuviæ reddish-yellow. Grouped glands present. On palms. Europe. (Nomen seminudum.)

A. (*subg.?*) **pandani** Sign.—♀ scale blackish-brown, center whitish. Grouped glands present. On *Pandanus utilis.* (Essai, 1869, p. 131.)

A. (*Diaspidiotus*) **perniciosus** Comst.—United States (Ala., Ariz., Cal., Del., Fla., Ga., Idaho, Ind., La., Mass., Md., N. J., N. Y., N. M., Ohio, Oreg., Pa., Va., Washington, W. Va.), British Columbia, Australia, Sandwich Islands. (For full particulars see Bull. 3, n. s., Div. Ent. The San Jose scale; by L. O. Howard and C. L. Marlatt.)

A species perhaps allied to *perniciosus,* but possibly new, was found by Prof. C. H. T. Townsend on *Fraxinus* at Brownsville, Texas. The scales were attacked by some parasite, and it proved impossible to satisfactorily describe or figure the species. The scale is more convex than *perniciosus,* the exuviæ are dark; the median lobes are quite elongated.

A. (*Aspidiotus s. str.?*) **phormii** de Breme.—♀ scale white, circular; exuviæ central. On *Phormium tenax* in Switzerland. (Signoret, Essai, 1869, p. 130.)

A. (*Hemiberlesia*) **rapax** Comst.—♀ scale convex, gray, appearing yellowish from the contained insect; exuviæ toward one side, marked by a dark brown or black spot. ♀ with one pair of large lobes; branched plates; no groups of ventral glands. On various trees, etc.; nearly cosmopolitan.

A. (*Chrysomphalus*) **sphæricides** Ckll.—♀ scale circular, rather over 1 mm. diam.; moderately convex; dark reddish-brown, with the part covering the exuviæ indicated by a pale raised ring; when rubbed the exuviæ appear shining black. ♀ with three pairs of lobes; five groups of ventral glands, caudolaterals, 3; cephalolaterals, 4; median, 3. Said to be on New Zealand flax. Louisiana.

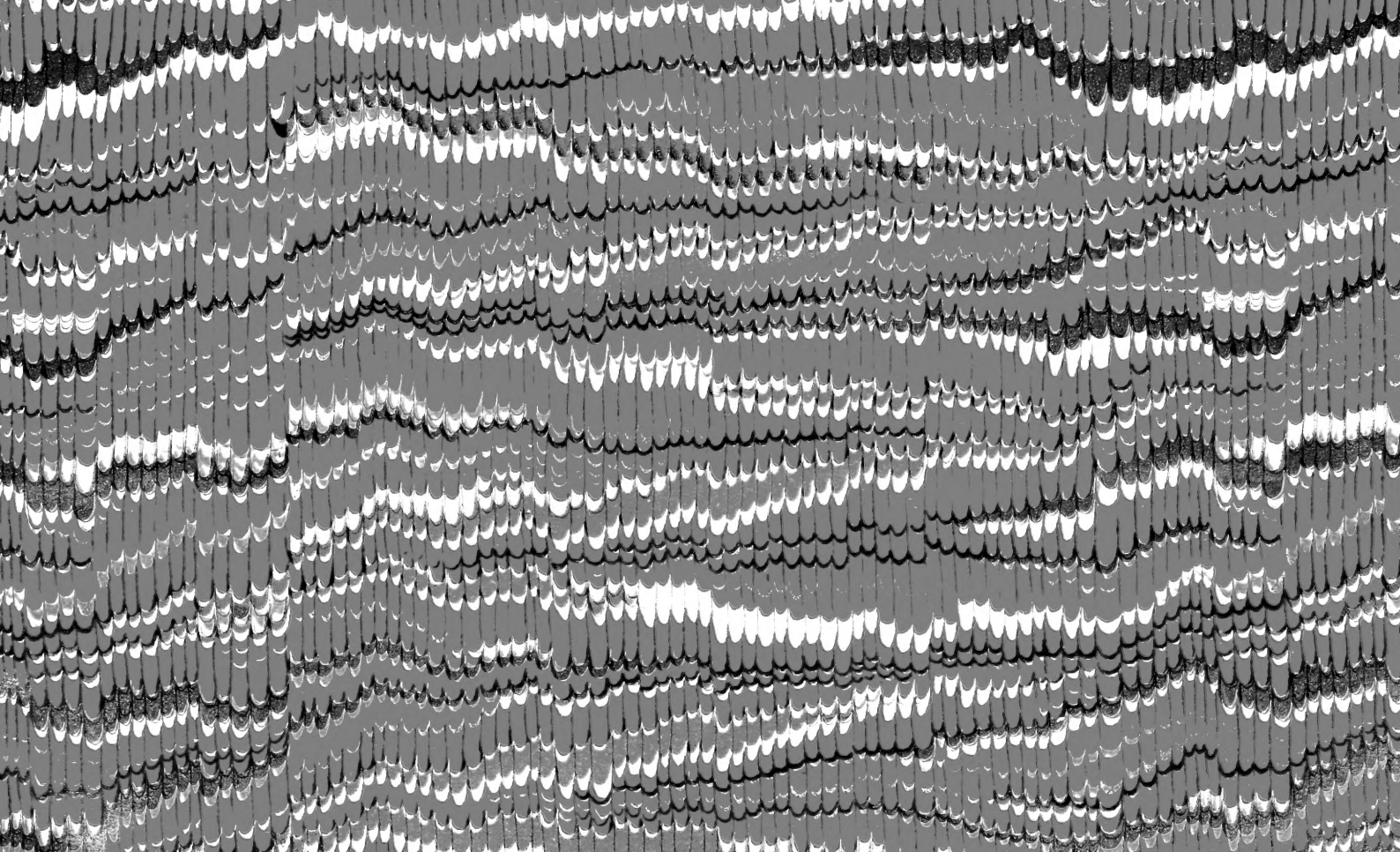
A. (*Aspidiotus s. str.*) **spinosus** Comst.—♀ scale circular, very light brown or dirty white; exuviæ central and covered. 4 groups of ventral glands, of not over 6 each; median lobes prominent; plates more or less notched; spines large. On camellia. Washington, D. C.

A. (*Aspidiotus s. str.*) **vriesciæ** Sign.—Allied to *nerii;* scale more elongated, yellowish gray. On *Vriesia splendens.*

A. (?) *osmanthi* Vallot, 1829, a white scale with central exuviæ, found on *Olea fragrans,* is at best a *nomen seminudum.*

POSTSCRIPT.

Since this Bulletin went to press I have received an interesting note from Dr. G. Leonardi, to whom I had communicated some of my views by letter. One of the subgenera which I had proposed, having for its type *A. secretus*, proved to be identical with a new genus (*Odonaspis*) of Dr. Leonardi's. I therefore adopt his name and suppress my own; though it is to be remarked that if *Odonaspis* is from *ὀδούς-ἀσπίς* it is equivalent to *Odontaspis*, preoccupied by Agassiz. Dr. Leonardi goes on to say that he would refer *Melanaspis* to *Chrysomphalus*, *Xerophilaspis* to *Targionia*, and *Cryptophyllaspis* and *Selenaspidus* to *Aspidiotus*, s. str., in which they will represent sections. The change of *Aspidites* to *Hemiberlesia* is assented to, and the generic value of *Chrysomphalus* and *Aonidiella* is maintained. At the same time Dr. Leonardi has published (Riv. Pat. Veget., 1897) a preliminary classification of *Aspidiotus*, dividing it into the following groups, which are all regarded as genera: *Aspidiotus*, *Aspidites*, *Chrysomphalus*, *Aonidiella*, *Targionia*, *Odonaspis*, *Chentraspis*, *Phaulaspis*—the last three new—and with *Aonidia* added. I can not at all agree with this classification, which throws into the same genus (*Aonidiella*) such diverse species as *A. aurantii*, *perniciosus*, and *mimosæ*, while it places *perniciosus* and *ancylus* in separate genera! However, it is intended only as a preliminary statement, and no doubt the author will greatly improve it in his detailed publication and explain away some of the apparent difficulties.



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